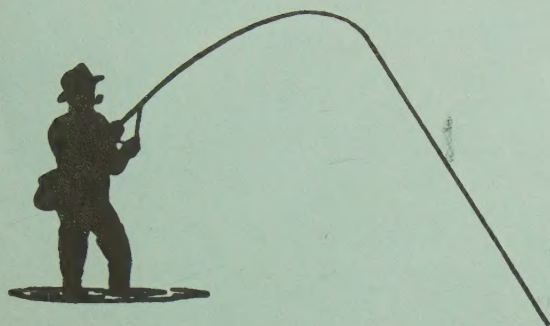


21(5)

21(3)



LIBRARY
AUG 9 1977
FISH & WILDLIFE SERVICE

SPORT FISHERY ABSTRACTS

Vol. 21, No. 3, 1976



DEPARTMENT OF THE INTERIOR
U. S. FISH AND WILDLIFE SERVICE

UNITED STATES DEPARTMENT OF THE INTERIOR
THOMAS S. KLEPPE, SECRETARY

Nathaniel P. Reed, *Assistant Secretary for Fish and Wildlife and Parks*
Fish and Wildlife Service, Lynn A. Greenwalt, Director



SPORT FISHERY ABSTRACTS

Roger Schoumacher, Editor
Terry N. Sexson, Assistant Editor

Editorial Office
U.S. Fish and Wildlife Service
Aylesworth Hall, CSU
Fort Collins, Colorado 80523

Sport Fishery Abstracts is intended to furnish fishery biologists with abstracts of current literature in sport fishery research and management.

One volume, consisting of four numbers, is issued each year. Each number contains separate Author, Geographic, and Taxonomic indexes, and the final number of each volume contains cumulative Author, Geographic, Taxonomic, and Subject indexes, and a list of publications screened. Authors who publish in journals not screened for *Sport Fishery Abstracts*, and who would like their publications included, should submit abstracts to the Editor.

The U.S. Fish and Wildlife Service assumes no responsibility for the accuracy of material from outside sources, and can only supply copies of articles written and published by the U.S. Fish and Wildlife Service.

*Use of funds for printing this publication approved by the
Director of the Office of Management and Budget, March 3, 1976.*

RESULTS OF A SURVEY OF RECIPIENTS OF

SPORT FISHERY ABSTRACTS

A survey of the recipients of Sport Fishery Abstracts was conducted in June 1976 to solicit opinions on format and content, and to determine whether they would be willing to pay \$4.00 per year if such a charge were imposed. Questionnaires were sent to 262 individuals--approximately 10% of the mailing list. A total of 195 (74%) were returned. No follow-up survey of non-respondents was made on the assumption that their response would not significantly alter the results.

The readership consists of 24% Federal employees, 33% State or Provincial, 27% University and 16% with other affiliations. Fifteen percent were involved primarily in administration, 47% research, 29% management, and 9% other activities. Fifty-nine percent used Sport Fishery Abstracts primarily to scan current literature, whereas 41% used it primarily to locate references for specific research or management projects. Ninety-seven percent favored continuation of the present format of citations and abstracts, as opposed to citations only or other formats. Forty-one percent rated Sport Fishery Abstracts excellent, 52% good, and 7 percent fair. None rated it poor.

Primary journals and federal and state technical publications were given high priority for inclusion, whereas symposia and foreign publications (in English) were given intermediate to high priority. Foreign articles with English summaries and theses were given intermediate priority, popular articles covering research and management results intermediate to low priority, and foreign articles without English summaries low priority.



Digitized by the Internet Archive
in 2025



SPORT FISHERY ABSTRACTS

An abstracting service for fishery research and management

Volume 21 Number 3

1976

CONTENTS

AQUATIC PLANTS AND THEIR CONTROL	1
CULTURE AND PROPAGATION	
General Fish Culture	1
Trout and Salmon Culture	2
Other Anadromous Species Culture	3
Warmwater Culture	4
Mariculture	7
Feeds, Feeding and Nutrition	8
Transporting Fish	11
Miscellaneous Culture Techniques and Equipment	12
LIMNOLOGY AND OCEANOGRAPHY	
General	12
Physical	12
Chemical	12
Benthos	13
Primary Production	13
MORPHOLOGY, PHYSIOLOGY, GENETICS AND BEHAVIOR	
Morphology	14
Physiology	17
Genetics, Variation Studies, Hybridization	25
Behavior	26
NATURAL HISTORY	
Life Histories - General Works	28
Population Studies - Production, Standing Crop, Recruitment	32
Spawning Habits and Movements, Sex Ratios, Fecundity, etc.	35
Movement - Seasonal and Depth Distributions, etc.	39
Foods and Feeding	41
Age and Growth	47
Geographical Distribution, Fish Surveys, etc.	50
Abundance, Factors of; Survival and Mortality	54
Identification, Keys, Classification	56
PARASITES AND DISEASES	
General	59
Bacterial	59
Protozoan	60
Viral	60
Other	60
POLLUTION AND TOXICOLOGY	
Pollution	63
Toxicology; Bioassays	65
Fish Toxicants	78
RESEARCH AND MANAGEMENT	
General	79
Reports of Fishery Stations, States, etc.	81
Habitat Alteration	81
Harvest, Creel Census	82
Regulations	84
Fish Control and Removal	85

Marking and Tagging	85
Stocking and Introductions	87
Fishing Gear and Techniques	88
Fishways, Fish Passage through Dams, etc.	91
Mathematics, Statistical Methods and Modeling	91
Lake Management and Research	93
River and Stream Management	94
Farm Pond and Small Impoundment Management	95
Large Impoundment Management and Research	96
Marine Management and Research	98
Utilization of Fishery Products	99
Miscellaneous Techniques and Equipment	99
AUTHOR INDEX	101
GEOGRAPHIC INDEX	113
SYSTEMATIC INDEX	119

Camera copy for this issue of *Sport Fishery Abstracts* has been generated by computer programs developed and maintained by the Office of Library and Information Services, U.S. Department of the Interior, Washington, D.C.

AQUATIC PLANTS AND THEIR CONTROL

76-000914 Strange, R. J.; Berry, C. R.; Schreck, C. B. AQUATIC PLANT CONTROL AND RESERVOIR FISHERIES. IN H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 513-521. 1975. SFA 21(3).

[Dep. Fish. Wildl. Sci., VPI & SU, Blacksburg, VA 24061]

76-000915 Terrell, J. W.; Fox, A. C. MACROPHYTE CONTROL BY GRASS CARP IN CATFISH PONDS. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 235-242. 1975. SFA 21(3).

[U.S. FWS, Ga. Coop. Fish. Res. Unit., Univ. Ga., Athens 30602] Macrophyte standing crop (primarily /Eleocharis/ and /Utricularia/) was reduced nearly 90 percent in two catfish ponds after introduction of grass carp (/Ctenopharyngodon idella/). Abundant vegetation remained in 1-m² enclosures placed in the ponds as controls. The stocking ratio of grass carp (live weight) to macrophyte standing crop (dry weight) that resulted in vegetation control within 1 year was 0.15 in the pond in which the fish were fed pelleted food and 0.06 in the pond in which the fish were not fed. Scattering of feed over the entire pond rather than confining it to a few locations may have discouraged grass carp from feeding on pellets and contributed to the success of vegetation control.

GENERAL FISH CULTURE

76-000916 Kikuchi, W. K. PREHISTORIC HAWAIIAN FISHPONDS. Science 193 (4250): 295-299. July 1976. SFA 21(3).

[Kauai Comm. Coll., Lihue, HI] One of the important technological concepts that was developed in the Hawaiian Islands is that of the fishpond. From the 14th to the 19th centuries, these sites served as aquariums for the raising of selected fish. From its inception until the 1900's, the fishpond progressed little in design and function. Its rudimentary nature was a function of both technology and religion. Because of the open ditches, sluice gates, and permeable walls, neither the types nor the quantity of juvenile fish entering or leaving could be controlled. In addition, religious beliefs prevented experimenting with fertilization to increase yield. Although seemingly inefficient, the native aquacultural system was not intended to produce a great amount of fish but rather to yield selected fish on call. Fishponds became symbols of the chiefly right to conspicuous consumption and to ownership of the land and its resources. They were manifestations of the chief's political power and his ability to control and tap his resources. As soon as the native aristocracy changed to a Western-style kingdom, the fishpond's function changed, until, by the 1930's, the majority were simply archeological remains--mounds and walls of rock along a river or shore.--Summ.



76-000917 Stanley, J. G.; Jones, J. B. INCUBATORS FOR SEMIBUOYANT EGGS. Prog. Fish-Cult. 38 (2): 98. Apr. 1976. SFA 21(3).

[U.S. FWS, Fish Farming Exp. Stn., Stuttgart, AR 72160] Large pots (220-liter capacity, 45° conical bottom) and saran-screen baskets (12 x 20 cm, 10 cm deep) were compared with McDonald jars for hatching the semibuoyant eggs of grass carp (*Ctenopharyngodon idella*). The pots and baskets were equally effective and were superior to traditional 8-liter McDonald jars, as measured by percentage yield of fry. The devices should be suitable incubators for semibuoyant eggs of other species.

TROUT AND SALMON CULTURE

76-000918 Donaldson, L. R.; Brannon, E. L. THE USE OF WARMED WATER TO ACCELERATE THE PRODUCTION OF COHO SALMON. Fisheries (Bull. Am. Fish. Soc.) 1 (4): 12-16. July-Aug. 1976. SFA 21(3).

[Coll. Fish., Univ. Wash., Seattle] Coho salmon, *Oncorhynchus kisutch* enter coastal streams from northern California to the Bering Sea to spawn. Spawning takes place in late fall, with the young fingerlings migrating to sea about 18 months later. Most of the fish return in the third year as mature adults. As natural runs have decreased, governmental agencies--state, provincial, and Federal--have developed facilities and procedures to produce millions of 18-month-reared fingerling coho for release to the sea. During the past 10 years, a program of accelerating the growth of coho has evolved at the College of Fisheries, University of Washington, that uses improved diets and warmed water to increase the growth of young coho to produce fingerling migrants in 6 months instead of the usual 18 months required in hatchery operations. Most of the accelerated smolts return from the sea after 18 months, or at 2 years of age, as normal adults, with the number increasing over the years from 0.39 percent (1971) ocean survival to more than 6.0 percent (1975).

76-000919 Kyazimov, I. B.; Alekperov, A. P. COMPLETION OF REARING OF UNDERYEARLINGS OF THE CASPIAN SALMON *SALMO TRUTTA CASPIUS* IN WINTER IN THE LOWER REACHES OF THE KURA RIVER. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiul.) 15 (2): 256-264. 1975. SFA 21(3).

[Cent. Sci. Res. Inst. Sturgeon Farm., Baku, USSR] The method of rearing underyearlings of the Caspian salmon, *Salmo trutta caspius*, in winter in the lower reaches of the Kura River made it possible to establish the optimum conditions of rearing, as a result of which the proportion of downstream migrants has increased, the percentage of dwarf fishes has decreased and the period of hatchery-rearing of young fishes has been curtailed to 5-6 months; the possibility of obtaining downstream migrants from freshwater spawners (trout) is also practicable.

76-000920 Mathews, S. B.; Mock, J. B.; Willson, K.; Senn, H. ENERGY EFFICIENCY OF PACIFIC SALMON AQUACULTURE. Prog. Fish-Cult. 38 (2): 102-106. Apr. 1976. SFA 21(3).

[Coll. Fish., Univ. Wash., Seattle 98195] Energy efficiency ratios (kilocalories of consumable food per kilocalories of inputs by man in production) were estimated for rearing salmon to marketable size in floating pens and for standard hatchery production of chinook (*Oncorhynchus tshawytscha*) and coho (*O. kisutch*). Efficiency ratios were 13 percent and 25 percent, respectively, for pen rearing and hatchery production. The major energy inputs were for food in pen

SPORT FISHERY ABSTRACTS

76-000920 CONTINUED

rearing, and for pumping water, pond construction, and food for hatcheries. Energy efficiency of hatchery production could be substantially increased by low-energy-use rearing techniques such as floating pens.

76-000921 Senn, H. G.; Hager, R. COMPARISON OF SEA WATER WITH FRESH WATER IN REARING CHUM SALMON SMOLTS. Prog. Fish-Cult. 38 (2): 108-109. Apr. 1976. SFA 21(3).

[Wash. Dep. Fish., Olympia 98504] Hood Canal chum salmon (*Oncorhynchus keta*) from the 1973 brood were randomly divided into three lots after rearing for 35 days. Each group was identified by a unique fin mark. Lot A was released immediately, Lot B was reared to 57 days in mixed fresh water and sea water (18 percent), and Lot C was reared for the same time in fresh water. Returning adult 3- and 4-yr-olds were sampled for returns of marked fish. Returns of 4-yr-olds were sampled for length. Additional rearing did not appear to increase final size at return as 4-yr-olds. Survival to maturity was similar for smolts reared in fresh water and in mixed fresh water and sea water for an equal period of time; however, the study indicated that additional rearing time increases survival to maturity.

OTHER ANADROMOUS SPECIES CULTURE

76-000922 Bishop, R. D. THE USE OF CIRCULAR TANKS FOR SPAWNING STRIPED BASS (*MORONE SAXATILIS*). Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 35-44. 1975. SFA 21(3).

[Tenn. Wildl. Resour. Agency, Morristown] During the 1974 spawning season in Tennessee, 17 female striped bass were injected with chorionic gonadotropin and placed in circular tanks to spawn. One or more males, also injected with gonadotropin, were placed in 13 of the tanks with each female. In four of the tanks, treated white bass males (*M. chrysops*) were added in an attempt to produce hybrids. All 13 of the females, where there were no white bass, successfully spawned producing an estimated 19.3 million eggs. More than 11 million fry hatched. The four females in tanks containing white bass males ripened but had to be manually stripped. The tank spawning method requires considerably less handling and imposes much less stress on brood fish than the conventional hormone technique.

76-000923 Braschler, E. W. DEVELOPMENT OF POND CULTURE TECHNIQUES FOR STRIPED BASS *MORONE SAXATILIS* (WALBAUM). Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 44-48. 1975. SFA 21(3).

[U.S. FWS, Atlanta, GA] The increasing demand for striped bass fingerlings has established a need for improved pond culture techniques for this species. Standard guidelines were developed from methods in use at several production hatcheries. These along with improvements after two production seasons are described.

76-000924 Germann, J. F.; Reeves, W. C. THE EFFECTS OF ADDED HARDNESS, SALINITY, AND SOURCE OF FRY ON THE SURVIVAL AND GROWTH OF STRIPED BASS FRY IN HATCHING JARS. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 199-208. 1975. SFA 21(3).

[Ga. Game Fish Div., Fitzgerald] The effects of increased water hardness, salinity, and source of fry on the survival and growth of striped bass fry from three females from the Cooper River, South Carolina, and two females from the Savannah River, Georgia, were studied at the Fisheries Research Unit, Auburn University, from 6

76-000924 CONTINUED

April to 11 June, 1971. Fry were stocked in one of three water treatments: control with a total hardness of 30 to 40 ppm; added hardness, 125 to 175 ppm; and added salinity, (chlorides) 1,100 to 1500 ppm. Variance tests for homogeneity and contingency tables were employed for data analysis. Survival of striped bass fry was increased in the added salinity treatment. Fry survival in the control and added hardness treatments appeared to be dependent on the fry groups rather than the effects of the treatments. The survival of Cooper River fry appeared to be more variable in water with added hardness; Savannah River fry survival was more variable in the control treatment. The effects of added hardness and added salinity treatments on Savannah River fry survival were similar. Growth of fry in the added hardness and added salinity treatments was slightly greater than growth of fry in the control. The cause of the growth increase was not known.

76-000925 Stevens, R. E. STRIPED BASS CULTURE AND MANAGEMENT: MODERATOR'S OPENING COMMENTS. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 35. 1975. SFA 21(3).
[Marine Protein Corp., Miami, FL]

76-000926 Ware, F. J. PROGRESS WITH /MORONE/ HYBRIDS IN FRESH WATER. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 48-54. 1975. SFA 21(3).

[Fla. Game Fresh Water Fish Comm., Tallahassee 32304] A brief history of developments with /Morone/ hybrids is given. Two of these fishes have shown potential as a supplemental sport fish for fresh water lakes and reservoirs. The original hybrid, white bass male X striped bass female, has provided substantial fisheries in the Southeast. Compared to striped bass, greater returns to sport fishermen, faster early growth, and higher survival has been documented. The threat of backcross deformities appears minimal at this time. The reciprocal hybrid, striped bass male X white bass female, was successfully cultured in 1970. Early findings have been encouraging, but data is incomplete for conclusive evaluation. First year growth varied between 12 and 14 inches, while average weights were higher than for striped bass of similar sizes. In general appearance, this hybrid resembles white bass. Life history aspects and culture methods for hybrid production are discussed.

WARMWATER CULTURE

76-000927 Childers, W. F. BASS GENETICS AS APPLIED TO CULTURE AND MANAGEMENT. IN H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 362-372. 1975. SFA 21(3).
[Ill. Nat. Hist. Surv., Urbana 61801]

76-000928 Gold, J. R.; Pipkin, R. E.; Gall, G. A. E. ARTIFICIAL HYBRIDIZATION BETWEEN RAINBOW (/SALMO GAIIRDNERI/) AND GOLDEN TROUT (/SALMO AGUABONITA/). Copeia 1976 (3): 597-598. Aug. 1976. SFA 21(3).

[Dep. Plant Sci., Texas A&M Univ., College Station 77843]

76-000929 Guest, W. C.; Avault, J. W., Jr.; Roussel, J. D. PRESERVATION OF CHANNEL CATFISH SPERM. Trans. Am. Fish. Soc. 105 (3): 469-474. May 1976. SFA 21(3).

[Texas Parks Wildl. Dep., Heart of the Hills Res. Stn., Junction Star Route, Box 62, Ingram, TX 78025] Three activators, eight extenders, and three protective agents at two concentration levels each were used to determine the best combination that will maintain in storage the viability of channel catfish (*Ictalurus punctatus*) sperm cells. There was a highly significant (P less than 0.01) difference in motility score among activators. Saline (0.65 percent) gave the highest motility score. Extended sperm cells became motile when activated after 2 months of storage at 4 C. Extender I (Truscott and Idler's Hfx No. 1) with 10 percent dimethyl sulfoxide (DMSO) and 2 hours equilibration produced the highest motility scores after freezing of 24 hours or 1 week. Freezing rate was controlled by placing vials of sperm in a double-layered, kapok-lined paper bag and freezing at the height of 127 mm above the liquid nitrogen level.

76-000930 Hill, T. K. COMPARISONS OF ALBINO AND NORMAL CHANNEL CATFISH GROWN IN CAGES IN A POND. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 231-235. 1975. SFA 21(3).

[Entomol. Fish. Dep., Coastal Plains Exp. Stn., Tifton, GA 31794] Albino and normal channel catfish, *Ictalurus punctatus* (Rafinesque), were stocked in suspended cages in a pond at densities of 11.1, 13.9 and 16.7 fish per ft³, respectively, with two replications of each. There were no apparent growth or survival differences between the albino and normal channel catfish. Mean gain/fish and mean gain/cage/day were significantly different (P 0.01) between the two higher stocking densities with both types of fish. These data indicate that a standing crop of about 15 lb per ft³ of cage is the maximum which can be grown in still water ponds.

76-000931 Inslee, T. D. INCREASED PRODUCTION OF SMALLMOUTH BASS FRY. IN H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 357-361. 1975. SFA 21(3).

[U.S. FWS, Tishomingo, OK]

76-000932 Lewis, W. M.; Wehr, L. W. A FISH-REARING SYSTEM INCORPORATING CAGES, WATER-CIRCULATION, AND SEWAGE REMOVAL. Prog. Fish-Cult. 38 (2): 78-81. Apr. 1976. SFA 21(3).

[Fish. Res. Lab., Dep. Zool., South. Ill. Univ., Carbondale 62901] A fish production system was designed that permits collection of solid waste, making it feasible to subject the waste to biofiltration. As a result of biofiltration, the biochemical oxygen demand in a pond can be reduced and the plant nutrients returned to the pond. The final design consists of cages 1.8 m in diameter, with solid, cone-shaped bottoms, that are connected by a manifold to a lift pump; the pump delivers the water to a biofiltration canal from which it is later returned to the pond.

76-000933 Merkowsky, A.; Avault, J. W., Jr. POLYCULTURE OF CHANNEL CATFISH AND HYBRID GRASS CARP. Prog. Fish-Cult. 38 (2): 76-77. Apr. 1976. SFA 21(3).

[Fish. Div., Sch. Forest. Wildl. Manage., La. State Univ., Baton Rouge 70803] When 0.04-ha earthen ponds were stocked with hybrid grass carp--male grass carp (*Ctenopharyngodon idella*) x female Israeli mirror carp (*Cyprinus carpio*)--at 50 or 100/ha with channel catfish (*Ictalurus punctatus*) stocked at 4,370/ha, and the fish were fed, the growth or production of the channel catfish was not affected.

76-000933 CONTINUED

The production of hybrid grass carp increased total fish production significantly (/P/ less than 0.05). When similar ponds were stocked with hybrid grass carp, stocked at 50 to 100/ha with channel catfish stocked at 750/ha, but the fish were not fed, there were significant decreases in channel catfish growth (/P/ less than 0.05) and production (/P/ less than 0.01). Total fish production in ponds stocked with only channel catfish did not differ significantly (/P/ greater than 0.05) from that in ponds stocked with a combination of channel catfish and hybrid grass carp.

76-000934 Mires, D. PRIMARY NURSING OF CARP FINGERLINGS IN TANKS. Bamidegh 28 (1/2): 18-24. 1976. SFA 21(3).

[fish Hatchery, Kibbutz Ein Hamifratz, Israel] One hundred twenty-two thousand carp fingerlings were grown in tanks from the time of hatching and until they attained a size of between 1.0 and 1.8 cm. This was possible due to feeding with zooplankton. The various zooplankton levels affected the growth rate and condition of the fry. Tank growth enabled transfer of the fry to nursery ponds in which they were grown to a weight of 0.3 gm and the entire loss was only 10 percent.--Summ.

76-000935 Rickett, J. D. GROWTH AND REPRODUCTION OF LARGEMOUTH BASS AND BLACK BULLHEADS CULTURED TOGETHER. Prog. Fish-Cult. 38 (2): 82-85. Apr. 1976. SFA 21(3).

[Biol. Dep., Univ. Ark., Little Rock 72204] Adult and yearling largemouth bass (/Micropterus salmoides/) and black bullheads (/Ictalurus melas/) were stocked in 0.04-ha experimental ponds at various ratios and recovered at the end of the growing season. Bass were also stocked alone, with channel catfish (/I. punctatus/), and with both channel catfish and bullheads. Yearling bass grew most rapidly when stocked with channel catfish. Growth was poorest for bass stocked alone without supplemental feed. Bass apparently had better reproductive success than bullheads when the two species were stocked together. When bass were stocked at 300/ha (120/acre) with bullheads at 1,250/ha (500/acre), reproduction of the bullheads was closely controlled. The addition of commercial fish food to some ponds enhanced fish production both directly and indirectly (by increasing the benthos). When young-of-the-year bass and bullheads were stocked together, bass grew faster initially but both reached an average length of 68 mm. Young bass alone reached an average length of 75 mm.

76-000936 Roseberg, R. B.; Kilambi, R. V. GROWTH AND PRODUCTION OF GOLDEN SHINER /NOTEMIGONUS CRYSOLEUCAS/ (MITCHILL), UNDER DIFFERENT STOCKING DENSITIES AND PROTEIN LEVELS. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 385-392. 1975. SFA 21(3).

[Dep. Zool., Univ. Ark., Fayetteville 72701] Golden shiner fry (0.18-0.21 g) were raised in 60-gallon tanks for a period of six months under constant temperature and photoperiod but varying stocking densities and protein levels in food. The stocking densities and protein levels were 20, 28, and 36 fish per tank, and 28, 33, and 38 percent protein. All the fish were fed at 5 percent of body weight. Growth in weight and production were evaluated in relation to stocking densities and protein levels. It was found that a density of 20 fish/60 gallons (100,000 fry per acre) and feed containing 33 percent protein were desirable for raising golden shiner.

SPORT FISHERY ABSTRACTS

76-000937 Snow, J. R. HATCHERY PROPAGATION OF THE BLACK BASSES. IN H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 344-356. 1975. SFA 21(3).
[Int. Cent. Aquaculture, Auburn Univ., Auburn, AL 36830]

76-000938 Wilbur, R. L.; Langford, F. USE OF HUMAN CHORIONIC GONADOTROPIN (HCG) TO PROMOTE GAMETIC PRODUCTION IN MALE AND FEMALE LARGEMOUTH BASS. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 242-250. 1975. SFA 21(3).

[Ariz. Game Fish Dep., Res. Div., 2222 West Greenway Rd., Phoenix 85023] Fifty male and 106 female largemouth bass were injected with human chorionic gonadotropin (HCG) during the 1972 and 1973 spawning seasons. Milt production was increased or maintained in 80 percent of the males tested, and 63 percent of the females ovulated. Females with spent or immature gonads did not noticeably respond to HCG injections. Females tested during the latter half of both spawning seasons demonstrated lower percentages of successful ovulations and reduced numbers of eggs per ovulation. Ninety percent of the ovulated females required only one injection, whereas nearly half of the females that resorbed their eggs required two injections before resorption could be determined. Results indicate that some females can be ovulated twice or three times with multiple injections, but that the success rate is too low to enable practical application. Most females ovulated within 48 hours of injection. Ovulated eggs, if not stripped and fertilized, became inviable within 12 to 16 hours of ovulation.

MARICULTURE

76-000939 Harache, Y.; Novotny, A. J. COHO SALMON FARMING IN FRANCE. Mar. Fish. Rev. 38 (8): 1-8. Aug. 1976. In English with French summ. SFA 21(3).

[Cent. Natl. Explor. Oceans, Cent. Oceanol. Bretagne, Brest, France] The coast of Bretagne (/Brittany/) in France offers many suitable sites for salmon aquaculture. Seawater temperature varies from 8 to 18.5°C, but unusual climatic conditions may induce peak temperatures of 20°C. Coho salmon research was induced in France in 1971 by a CNEXO-COB (Centre National pour l'Exploration des Oceans/Centre Oceanologique de Bretagne) research team, in close relationship with NOAA-NMFS specialists. The results in freshwater-rearing were excellent, with high survival and good growth under natural conditions, leading to a large percentage of young-of-the-year (0-age) smolts. The first year of operation of an experimental saltwater, diked, tidal pond produced 7.6 metric tons of coho salmon in 1974 and 22 tons in 1975. Another pilot plant, built in June 1974, used net-pens in the Rade de Brest and produced about 4 tons. Late spring and summer adaptation of smolts to seawater showed heavy mortality during the summer of 1974 and 1975, possibly due to high temperatures associated with high salinities. No evidence of bacterial infection was found in 1974, but *Vibrio* sp. was isolated from dying fish in 1975. However, the surviving fish showed excellent growth. Part of the 0-age 26 g smolts, adapted in July 1974, reverted to parr condition with poor growth, while the other part of the population reached an average weight of 397 g by 31 December (1.58 percent daily weight increase) and 735 g by 10 April 1975. Large 1-year smolts averaged 522 g by 31 December (1.25 percent daily weight increase) and 1,050 g by 9 April 1975. The salmon are reared in saltwater from October to May, when the sea temperature is below 13°C. The coho are marketed in France--fresh, whole, and in the size range of 0.3-0.8 kg. Market prices and acceptance are excellent. Total production should approach

76-000939 CCNTINUED
100-120 tons in 1976 in three operating farms.

FEEDS, FEEDING AND NUTRITION

76-000940 Barwick, D. H. EFFECT OF TWO FEEDING RATES ON PRODUCTION OF ADVANCED FINGERLING STRIPED BASS. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 194-199. 1975. SFA 21(3).
[U.S. FWS, Clemson, SC 29631] An investigation of the effect of two feeding rates on pond production of advanced fingerling striped bass was studied at the Auburn University Fisheries Research Unit from June 27 to November 24, 1972. The mean survival for fingerlings fed a high feeding rate was 71.87 percent as opposed to 70.13 percent for fingerlings fed a low feeding rate. Mean production for fingerlings fed a high and low feeding rate was 266.44 kg/ha and 293.68 kg/ha, respectively. Food conversion for fingerlings fed a high feeding rate was 3.74 as compared to 2.51 for fingerlings fed a low feeding rate.

76-000941 Dove, G. R.; Tiemier, O. W.; Deyoe, C. W. EFFECTS OF THREE DIETS ON GROWTH AND MINERAL RETENTION OF CHANNEL CATFISH FINGERLINGS. Trans. Am. Fish. Soc. 105 (3): 481-485. May 1976. SFA 21(3).

[Dep. Biol., Friends Univ., Wichita, KS 67213] Supplemental feeds containing different calcium and phosphorus concentrations and protein sources significantly affected whole-fish and lipid-free bone levels of calcium, phosphorus, and magnesium in fingerling channel catfish, *Ictalurus punctatus*.

76-000942 Flickinger, S. A.; Anderson, R. J.; Puttmann, S. J. INTENSIVE CULTURE OF SMALLMOUTH BASS. IN H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 373-379. 1975. SFA 21(3).

[Dep. Fish Wildl., Colo. State Univ., Fort Collins 80523]

76-000943 Lovell, R. T.; Prather, E. E.; Tres-Dick, J.; Chhorn, L. EFFECTS OF ADDITION OF FISH MEAL TO ALL-PLANT FEEDS ON THE DIETARY PROTEIN NEEDS OF CHANNEL CATFISH IN PONDS. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 222-228. 1975. SFA 21(3).

[Agric. Exp. Stn., Auburn Univ., Auburn, AL 36830] Channel catfish were stocked in 27, 1/10-acre ponds at the rate of 3,000 per acre and fed nine commercial-type rations containing three protein percentages and three levels of fish meal for 200 days. Average survival for the experiment was 96.8 percent and 93 percent of the fish were over 12 inches in length at harvest. Average yield for treatments ranged from 2,330 to 3,030 lb/acre and the average for all treatments was 2,638 lb. The results indicated that satisfactory production can be obtained with all-plant rations. The 29 percent, all-plant protein diet yielded 2,330 lb/acre of harvestable size fish. Increasing total protein in the all-plant rations to 36 and 43 percent resulted in production of 2,475 and 2,640 lb/acre, respectively. Replacing 1/6 of the plant protein with fish meal protein, at the 29 per cent protein level, increased production by 100 lb/acre; however, replacing 1/3 of plant protein with fish meal protein yielded an increase of 430 lb. At the 36 and 43 percent protein levels, 1/6 fish meal protein significantly (P less than .05) increased weight gains over the all-plant protein rations; however, a further increase to 1/3 fish meal protein did not significantly increase fish yield. Under these management conditions and current feed ingredient costs, the extra yields obtained by

76-000943 CONTINUED

increasing protein level and replacing plant protein with fish meal protein were profitable; particularly in the 36 or 43 percent protein diets in which $1/6$ of the protein was fish meal.

76-000944 Lovell, R. T.; Sirikul, B. WINTER FEEDING OF CHANNEL CATFISH. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 208-216. 1975. SFA 21(3).

[Dep. Fish. Allied Aquacultures, Auburn Univ., Agric. Exp. Stn., Auburn, AL] On November 24, 1973, pound-size channel catfish, which had previously been fed intensively for 6 months, were weighed and measured and placed back into nine $1/10$ -acre earthen ponds at the rate of 2,000 per acre. The fish were managed through the winter until the following March 4 on one of three feeding regimes; no feeding; feeding 1 percent of fish weight on alternate days; and feeding 1 percent of fish weight only on "warm" days or when water temperature at a 3-foot depth was above 54 F. Fish not fed lost 9 percent of their weight during the 100-day over-winter period, those fed on alternate days received feed on 51 days and gained 23 percent, and those fed on the "warm" days received feed on 52 days and gained 19 percent. Condition factors increased for both groups of fed fish but decreased for the nonfed fish. Length increased slightly for all groups. Although the nonfed fish lost weight, they had the highest percentage of body fat indicating that a significant amount of tissue protein was degraded for energy needs.

76-000945 Loyacano, H. A., Jr. PUPAE OF FACE FLY AS FOOD FOR CHANNEL CATFISH. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 228-231. 1975. SFA 21(3).

[Dep. Entomol. Econ. Zool., Clemson Univ., Clemson, SC 29631] Pupae of face fly (*Musca autumnalis* De Geer) were offered to channel catfish fingerlings fed outdoors in plastic pools. Other channel catfish fingerlings received rations of equal parts of face fly pupae and Purina Catfish Cage Chow (pellets) or pellets only. After 9 weeks of feeding, catfish from each pool were counted and weighed. Survival rates were 94, 97, and 93 percent and ratios of dry weight of food to increase in live weight of fish were 1.62, 1.77, and 2.29 for fish receiving pupae, pupae and pellets mixed, and pellets only, respectively. There were no statistically significant differences between these values ($P = .05$).

76-000946 MacFarlane, L. R. AUTOMATIC FEEDER FOR DELIVERY OF HIGH-FAT STARTER FOOD TO SWIM-UP FRY OF ATLANTIC SALMON. Prog. Fish-Cult. 38 (2): 106-107. Apr. 1976. SFA 21(3).

[Dep. Environ., Fish. Mar. Serv., Biol. Stn., St. Andrews, NB E0G 2X0 Canada] An automatic feeder for feeding adhesive high-fat starter food to swim-up fry of Atlantic salmon (*Salmo salar*) is described. Food is delivered to separate trays of fry from shaker jars mounted on a rotating shaft. The quantity of food delivered and the time of delivery are controlled by an electric clock motor, timer, and variable speed motor coupled to the rotating shaft by a bicycle sprocket and chain. The feeder should be especially useful for dispensing diets in studies of growth and nutrition.

76-000947 Nagel, T. INTENSIVE CULTURE OF FINGERLING WALLEYES ON FORMULATED FEEDS. Prog. Fish-Cult. 38 (2): 90-91. Apr. 1976. SFA 21(3).

[London Fish Hatchery, Ohio Dep. Nat. Resour., London 43140] Experiments were conducted to develop techniques for rearing fingerling walleyes (*Stizostedion vitreum*) by intensive culture on formulated feeds. In 1975, when 20,000 2.5- to 3.8-cm (1- to 1.5-in.) walleye fingerlings were used to test the feasibility of feeding the Oregon Moist Pellet diet and dry diets to this species in intensive culture, 8,130 (40.7 percent) were reared to lengths of 8.9 to 12.7 cm (3.5 to 5 in.). Mortality due to associated columnaris, fin rot, and bacterial gill disease was effectively controlled by copper sulfate treatments.

76-000948 Poston, H. A. OPTIMUM LEVEL OF DIETARY BIOTIN FOR GROWTH, FEED UTILIZATION, AND SWIMMING STAMINA OF FINGERLING LAKE TROUT (*SALVELINUS NAMAYCUSH*). J. Fish. Res. Board Can. 33 (8): 1803-1806. Aug. 1976. In English with French summ. SFA 21(3).

[U.S. FWS, Tunison Lab. Fish. Nutr., Cortland, NY 13045] Triplicate lots of fingerling lake trout (*Salvelinus fontinalis*) held at 9 C for 20 wk were fed a semipurified basal diet supplemented with 1 percent spray-dried egg white or d-biotin at concentrations of 0.1, 0.5, 1.0, or 5.0 ppm. Trout fed the basal diet, either alone or with egg white, grew more slowly and converted feed less efficiently (*P*/less than 0.05) than those fed supplemental biotin. Neither the growth rate nor feed conversion differed significantly among the four groups fed supplemental biotin. However, when forced to swim to exhaustion against controlled water currents, trout fed either basal diet, with or without egg white, or 0.1 ppm supplemental biotin, swam a shorter distance (*P*/less than 0.05) than those fed more biotin. Fish fed 0.5 ppm biotin swam as far as those fed 1.0 ppm, but not as far as those fed 5.0 ppm. These results indicate that young lake trout probably need no more than 0.1 ppm biotin for optimum growth and feed conversion, but require from 0.5 to 1.0 ppm for optimum swimming stamina.

76-000949 Poston, H. A. RELATIVE EFFECT OF TWO DIETARY WATER-SOLUBLE ANALOGUES OF MENAQUINONE ON COAGULATION AND PACKED CELL VOLUME OF BLOOD OF LAKE TROUT (*SALVELINUS NAMAYCUSH*). J. Fish. Res. Board Can. 33 (8): 1791-1793. Aug. 1976. In English with French summ. SFA 21(3).

[U.S. FWS, Tunison Lab. Fish Nutr., Cortland, NY 13045] Triplicate lots of fingerling lake trout (*Salvelinus namaycush*) (initial mean weight, 5.3 g) were fed a basal, semipurified diet, or this basal diet supplemented with either 1.0 or 2.0 ppm of either menadione sodium bisulfite (MSB) or menadione dimethylpyrimidinyl bisulfite (MPB) for 18 wk at 14 C. Neither form of vitamin K had a significant effect on the growth, food conversion, or body composition of the fish. Fish fed 1 ppm of MSB had a significantly higher mean packed cell volume (PCV) than those fed 2 ppm of either analogue. Trout fed 2 ppm of MPB had an intermediate PCV which was not significantly different from that of trout fed either 1 ppm MPB or 2 ppm MSB. A dietary level of 1 ppm MPB (providing an equivalent menaquinone concentration of about 0.5 mg/kg of diet) is sufficient to insure normal coagulation of lake trout blood and a satisfactory PCV.

76-000950 Shcherbina, M. A. PHYSIOLOGICAL ASSESSMENT OF THE FOOD VALUE OF ARTIFICIAL FOODS FOR FISHES. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (2): 303-310. 1975. SFA 21(3).

[VNIIPRKh, Rybnoye Postal Dist., Moscow Province, USSR] A combined method is presented for the determination of the food value of artificial foods for fishes based on determination of the more important food components (in dry matter, crude protein and energy) according to six indicators.

76-000951 Spinelli, J.; Mahnken, C. EFFECT OF DIETS CONTAINING DOGFISH (/SQUALUS ACANTHIAS/) MEAL ON THE MERCURY CONTENT AND GROWTH OF PEN-REARED COHO SALMON (/ONCORHYNCHUS KISUTCH/). J. Fish. Res. Board Can. 33 (8): 1771-1778. Aug. 1976. In English with French summ. SFA 21(3).

[NMFS, Pac. Util. Res. Cent., Seattle, WA 98112] The use of dogfish (/Squalus acanthias/) meal as a complete replacement for herring or other low mercury (Hg) content fish meal in rations intended for rearing cultured salmon introduces the risk of producing fish that exceed the current U.S. FDA tolerance level of 0.5 ppm Hg. The amount of Hg that accumulates in the muscle is related not only to the total Hg content of the fish, but is probably also related to the form in which it is present in the diet and to other constituents that may react with the Hg in the diet. Our results indicate that dogfish meal may be used as a partial (Less than 50 percent) replacement for the fish meal portion of the diet without encountering Hg values (in the muscle) that exceed 0.5 ppm Hg. No evidence was found that naturally occurring chelating agents in dehydrated orange peel or polygalacturonic acid-cellulose complexes (PG) have the ability to chelate and prevent the deposition of Hg in either the muscle or the liver of the fish. It was observed that growth is decreased in coho salmon (/Oncorhynchus kisutch/) fed OMP-type diets in which 50 percent or more of herring meal was replaced with dogfish meal.

76-000952 Twongo, T. K.; MacCrimmon, H. R. SIGNIFICANCE OF THE TIMING OF INITIAL FEEDING IN HATCHERY RAINBOW TROUT, /SALMO GAIIRDNERI/. J. Fish. Res. Board Can. 33 (9): 1914-1921. Sept. 1976. In English with French summ. SFA 21(3).

[East African Mar. Fish. Res. Organ., Zanzibar, East Africa] The age of initial food ingestion and the influence of age at initial food presentation on alevin food intake, survival and subsequent growth were determined for rainbow trout, /Salmo gairdneri/. Alevins did not show any ingestive behavior nor was any food found in their gut, before initiation of swim-up. The withholding of food from the young fish for some time after swim-up did not impair their ability to learn to feed. Further, the most satisfactory time to initiate exogenous feeding of hatchery fish is when yolk reserves have been completely absorbed, bearing in mind that a considerable quantity of yolk may yet remain in the abdominal cavity after the externally visible yolk sac has disappeared. This study contradicts the hypothesis that delayed feeding of young rainbow trout causes or enhances the likelihood of nonfeeding.



SPORT FISHERY ABSTRACTS

76-000953 Westgate, J. W.; McKee, T. B.; Crawford, D. L.; Law, D. K. NUTRITIONAL EFFECTS OF USING "SALTY" HERRING MEAL IN OREGON MOIST PELLETS. Prog. Fish-Cult. 38 (2): 118-119. Apr. 1976. SFA 21(3).
[Oreg. Dep. Fish. Wildl. Comm., Clackamas 97015] Samples of "salty" herring (*Clupea harengus*) meals from fish used for roe production in British Columbia were tested in Oregon Moist Pellets fed to fingerling chinook salmon (*Oncorhynchus tshawytscha*). Feed consumption, weight gain, and feed and protein conversion were adversely affected by use of the salty meals.

MISCELLANEOUS CULTURE TECHNIQUES AND EQUIPMENT

76-000954 Marking, L. L.; Piper, R. G. CARBON FILTER FOR REMOVING THERAPEUTANTS FROM HATCHERY WATER. Prog. Fish-Cult. 38 (2): 69-72. Apr. 1976. SFA 21(3).
[U.S. FWS, Fish. Control Lab., La Crosse, WI 54601] A candidate fish therapeutant, Furanace, was chosen to demonstrate the use of activated carbon to remove drugs from treated water. This removal process may shorten the time for registration as well as reduce costs. A filter system was designed from a 55-gal drum that was capable of holding 45 kg (100 lb) of 20 X 40 mesh, activated carbon; a water pump; and a prefilter. A single unit removed Furanace from water flowing at a rate of 189 l/min (50 gal/min); 45 kg of carbon removed 3.5 kg of 10 percent granular Furanace from treated water. The filter efficiently removed Furanace after static or flow-through treatments of trout in a hatchery raceway.

GENERAL LIMNOLOGY AND OCEANOGRAPHY

76-000955 Dell, R. K. POST-WAR DEVELOPMENTS IN NEW ZEALAND OCEANOGRAPHY: A PERSONEL VIEW. N. Z. J. Mar. Freshwater Res. 10 (1): 1-14. Mar. 1976. SFA 21(3).
[Natl. Mus., Private Bag, Wellington, New Zealand]

PHYSICAL LIMNOLOGY AND OCEANOGRAPHY

76-000956 Brady, D. K. ARE THE CHESAPEAKE BAY WATERS WARMING UP? Chesapeake Sci. 17 (3): 225-227. Sept. 1976. SFA 21(3).
[Dep. Civ. Eng., Univ. Queensland, Brisbane, Australia Q4067]

CHEMICAL LIMNOLOGY AND OCEANOGRAPHY

76-000957 Cunningham, C. C.; Conrad, D. D. W.; Moffatt, J. D.; Levy, E. M. IMPROVED REAGENT DISPENSER FOR THE DETERMINATION OF DISSOLVED OXYGEN IN SEA WATER. J. Fish. Res. Board Can. 33 (9): 2076-2078. Sept. 1976. In English with French summ. 21(3).
[Dep. Environ., Atl. Oceanogr. Lab. Bedford Inst. Oceanogr., Dartmouth, NS B2Y 4A2, Canada]

SPORT FISHERY ABSTRACTS

76-000958 Larsen, D. P.; Mercier, H. T. PHOSPHORUS RETENTION CAPACITY OF LAKES. J. Fish. Res. Board Can. 33 (8): 1742-1750. Aug. 1976. In English with French summ. SFA 21(3).
[U.S. EPA, Environ. Res. Lab., Corvallis, OR 97330]

76-000959 Welch, H. E.; Dillon, P. J.; Sreedharan, A. FACTORS AFFECTING WINTER RESPIRATION IN ONTARIO LAKES. J. Fish. Res. Board Can. 33 (8): 1809-1815. Aug. 1976. In English with French summ. SFA 21(3).
[Dep. Environ., Fish. Mar. Serv., Biol. Stn., St. Andrews, NB E0G 2X0, Canada] Winter oxygen consumption was measured in 16 Ontario lakes. Whole lake respiration ranged from 0.08 to 0.39 g O₂ m⁻² day⁻¹ and was positively correlated with mean depth, phosphorus m⁻² at spring overturn, and summer chlorophyll /a/ m⁻². Morphological variables plus Secchi depth were explained over 80 percent of the variability in respiration rates.

BENTHOS

76-000960 Luedtke, R. J.; Brusven, M. A. EFFECTS OF SAND SEDIMENTATION ON COLONIZATION OF STREAM INSECTS. J. Fish. Res. Board Can. 33 (9): 1881-1886. Sept. 1976. In English with French summ. SFA 21(3).
[Fish. Bioassay Lab, Dep. Chem., Mont. State Univ., Bozeman 59715] Driftnets, basket samplers, and artificial streams were used to investigate the influence of heavy sand accumulations on insect drift, colonization, and upstream movements in Emerald Creek, northern Idaho. Most riffle insects successfully passed through low-velocity, sandy reaches 80 m long. Upstream movements on sand were impeded by flows as low as 12 cm/s, except for the heavily cased caddisfly /Dicosmoecus/ sp.

PRIMARY PRODUCTION

76-000961 Benfield, E. P.; Hendricks, A. C. EUTROPHIC GRADIENT IN SMITH MOUNTAIN LAKE, VIRGINIA. Va. J. Sci. 26 (1): 20-26. 1975. SFA 21(3).
[Cent. Environ. Stud., VPI & SU, Blacksburg, VA 24061] Smith Mountain Lake is the storage reservoir of the Smith Mountain-Leesville Pumped-Storage Hydroelectric Project located on the Roanoke and Blackwater Rivers, near Roanoke, Virginia. Due to the continuous introduction of municipal industrial effluents into the Roanoke River as it passes through the Roanoke Metropolitan Area, the headwaters of the Roanoke River Arm of the lake have become eutrophic. Employing the standard techniques for measuring primary production rates, chlorophyll-a concentrations, transparency and light penetration, and percent of saturation of dissolved oxygen, it was confirmed that the headwaters of the Roanoke River Arm do exhibit symptoms of eutrophy, and that there was a demonstrable gradient from eutrophic to mesotrophic conditions from the lake headwaters toward the Smith Mountain Dam.

76-000962 Hobson, L. A.; Morris, W. J.; Pirquet, K. T. THEORETICAL AND EXPERIMENTAL ANALYSIS OF THE ^{14}C TECHNIQUE AND ITS USE IN STUDIES OF PRIMARY PRODUCTION. J. Fish. Res. Board Can. 33 (8): 1715-1721. Aug. 1976. In English with French summ. SFA 21(3).

[Dep. Biol., Univ. Victoria, Victoria, BC V8W 2Y2, Canada] Theoretical and experimental field studies of ^{14}C uptake by marine phytoplankton were carried out to determine environmental conditions required for the technique to measure net photosynthesis. Results of theoretical studies indicate that rapidly metabolizing populations (rate constants for gross photosynthesis and respiration of 0.1 h^{-1} and 0.007 h^{-1} , respectively) may saturate with ^{14}C after about 30 h of continuous irradiation. Results of field studies indicate that a minimum of 24 h are required for net photosynthesis to be measured when daily irradiations exceed 20 cal cm^{-2} and nutrient limitation of photosynthesis does not occur. Additional measurements that may be made to aid in interpreting results obtained by the ^{14}C technique are briefly discussed.

76-000963 Stoeckner, J. G.; Shortreed, K. R. S. AUTOTROPHIC PRODUCTION IN CARNATION CREEK, A COASTAL RAINFOREST STREAM ON VANCOUVER ISLAND, BRITISH COLUMBIA. J. Fish. Res. Board Can. 33 (7): 1553-1563. July 1976. In English with French summ. SFA 21(3).

[Dep. Environ., Fish. Mar. Serv., Pac. Environ. Inst., West Vancouver, BC V7V 1N6, Canada] Attached algal growth in Carnation Creek and its estuary were monitored in 1974 and 1975 as part of the Carnation Creek Experiment Watershed Project. Net production on the estuary was $17.8\text{ ug organic matter (org) cm}^{-2}\cdot\text{day}^{-1}$, and in Carnation Creek the average was $3.4\text{ ug org cm}^{-2}\cdot\text{day}^{-1}$. Algal growth in Righerdon Creek, located in an adjacent logged watershed, was slightly higher ($4.6\text{ ug org cm}^{-2}\cdot\text{day}^{-1}$) than the Carnation Creek average. In a streamside nutrient enrichment experiment, nitrate and phosphate concentrations in one trough were increased to twice the normal Carnation Creek values present in the control. In 35 days the nutrient-enriched trough had a total algal volume 3 times that of the control. It is suggested that extremely low nutrient concentrations (especially phosphate), and secondarily, poor light conditions under the canopy, are responsible for the paucity of algal growth in Carnation Creek. Major loss of algae from the system is caused by periodic freshets which scour the stream bed. Losses by grazing herbivorous insects were considered negligible. Dominate diatoms in Carnation Creek were *Achnanthes minutissima*, *Synedra ulna*, *Bannaea arcus*, *Diatoma hiemale*, and *Eunotia pectinalis*. *Ulothrix* sp., *Draparnaldia* sp., and *Mougeotia* sp. were the dominant filamentous green algae. Net production and algal biomass (chlorophyll *a*) in Carnation Creek are among the lowest ever reported in the literature.

MORPHOLOGY

76-000964 Burdak, V. D. ON THE FUNCTIONAL IMPORTANCE OF THE RELIEF OF THE SURFACE OF THE GILL COVER IN FISH. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (4): 667-669. 1975. SFA 21(3).

[Inst. Biol. South. Seas, Sevastopol, USSR]

76-000965 Burr, B. M. A REVIEW OF THE MEXICAN STONEROLLER, /CAMPOSTOMA ORNATUM/ GIRARD (PISCES: CYPRINIDAE). Trans. San Diego Soc. Nat. Hist. 18 (7): 127-144. Mar. 1976. In English with Spanish summ. SFA 21(3).

[Ill. Nat. Hist. Surv., Urbana 61801]

76-000966 Filyushina, Ye. Ye.; Bakhmin, Ye. K. ELECTRON-MICROSCOPIC INVESTIGATION OF THE OLFACTORY EPITHELIUM OF THE BAIKAL OMUL /COREGONUS AUTUMNALIS MIGRATORIUS/. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (2): 284-290. 1975. SFA 21(3).

[USSR Acad. Sci., Novosibirsk, USSR] The peripheral part of the olfactory organ of the Baikal omul, /Coregonus autumnalis migratorius/, was investigated with the electron microscope. The presence of secondary folds, formed by the non-sensory epithelium with a large number of secretory elements, is characteristic of the olfactory lining. Rod-like receptor cells, with microvilli and cilia are found in the olfactory epithelium. Centricles are encountered in the non-ciliated cells with microvilli. The hypothesis is expressed that these cells are the precursors of the ciliated cells. Sustentacular and small and large secretory cells take part in the formation of mucus, the composition of which is mixed. The substances of this mucus probably participate directly in the process of odor perception.

76-000967 Garrick, J. A. F.; Inada, T. DIMENSIONS OF LONG-NOSED CHIMAERA /HARRICTTA RALEIGHANA/ FROM NEW ZEALAND. N. Z. J. Mar. Freshwater Res. 9 (2): 159-167. June 1975. SFA 21(3).

[Zool. Dep., Victoria Univ. Wellington, Private Bag, Wellington, New Zealand] The proportional dimensions of 66 adult specimens of /Harrictta raleighana/ Goode & Bean, 1895 (Holocephali: Rhinochimaeridae) from New Zealand are summarised; in both sexes there is considerable variation in proportions. Within the size range of the sample, the snout region of males is proportionately longer than that of females, and growth of the snout is negatively allometric in both sexes. Meagre data suggest that similar sexual dimorphism and allometry occur in North Atlantic specimens, though very large and very small specimens do not fit an extrapolation of the New Zealand data. None of the New Zealand males has the snout tip upturned and armed with large rounded knobs as described for North Atlantic males.

76-000968 Hunt, R. L. WILD BROOK TROUT WITH TWO ANAL FINS. Prog. Fish-Cult. 38 (2): 101. Apr. 1976. SFA 21(3).

[Wis. Dep. Nat. Resour., Waupaca 54981] A wild 3-yr-old brook trout (/Salvelinus fontinalis/) with two symmetrical anal fins was collected in Spring Creek, Chippewa County, Wisconsin, in October 1975. It has been donated to the ichthyological collection of the museum of the University of Wisconsin at Stevens Point.

76-000969 Jaspers, E. J.; Avault, J. W., Jr.; Roussel, J. D. SPERMATOZOAL MORPHOLOGY AND ULTRASTRUCTURE OF CHANNEL CATFISH, /ICTALURUS PUNCTATUS/. Trans. Am. Fish. Soc. 105 (3): 475-480. May 1976. SFA 21(3).

[I.Z.W.O., 69, Prinses Elizabethlaan, 8401 Bredene, Belgium] The morphology, dimensions, aberrations, and ultrastructure of channel catfish (/Ictalurus punctatus/) spermatozoa were studied. Spermatozoa of a wild catfish stock from Louisiana were compared to those of a domestic stock from Mississippi. The spermatozoon of channel catfish consists of a rounded dark head, a collar-like midpiece, and a long flagellum. The average dimensions were: head length, 2.3 μ m; midpiece

76-000969 CONTINUED

length, 1.6 μ m; midpiece width, 3.1 μ m; and flagellum length, 94.9 μ m. The flagellum had the classical (2.9 + 2) axoneme. On the average, 4.7 percent of the spermatozoa in the fish studied were biflagellar. Each flagellum arose from an individual centriolar complex. Domestic fish stock had a higher percentage of normal gametes compared to wild stock.

76-000970 Korovina, V. M. THE PARIETAL FONTANELLES IN THE CHONDROCRANIUM OF SALMON OF THE GENUS /ONCORHYNCHUS/. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (4): 629-635. 1975. SFA 21(3).

[Zool. Inst. Acad. Sci., Leningrad, USSR] In representatives of 6 species of salmon of the genus /Oncorhynchus/ (chum, pink, sockeye, coho, chinook and masu) in stages of early postembryonal ontogeny, the parietal fontanelles are well developed.

76-000971 Kovalevskaya, N. V. THE LARVAE AND FRY OF /CHEILOPOGON (PTENICHTHYS) INTERMEDIUS/ (EXOCOETIDAE, BELONIFORMES, PISCES). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (4): 672-675. 1975. SFA 21(3).

[Inst. Oceanol., Acad. Sci., Moscow, USSR]

76-000972 Moiseyeva, Ye. B.; Ponomareva, V. F. COMPARATIVE CHARACTERISTICS OF THE TESTES OF THE GOBIES /Gobius batrachocephalus/ AND /G. melanostomus/ IN DIFFERENT STAGES OF THE SEXUAL CYCLE. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (2): 264-273. 1975. SFA 21(3).

[AzChernIRO, Kerch, USSR] Morphological changes in the gametes, elements of the interstitial tissue and the glandular epithelium of the seminal vesicles of the "toad goby", /Gobius batrachocephalus/, in different stages of the sexual cycle were investigated. The comparative characteristics of the testes and seminal vesicles of the non-intermittently spawning "toad goby" and of the intermittently spawning "round goby", /G. melanostomus/, are given. The general morphology of the gametes is identical in both species. The sexual cycles of the "round goby" and "toad goby" differ sharply both as regards timing and nature of the separate stages of spermatogenesis.

76-000973 Nelson, E. M. SOME NOTES ON THE CHINESE SUCKER /MYXOCYPRINUS/. Copeia 1976 (3): 594-595. Aug. 1976.

[1127 Onley Dr., San Antonio, TX 78218]

76-000974 Tsokur, A. G. DATA ON THE DEVELOPEMENT OF THE MALAYAN HEADLIGHT FISH, /DIAPHUS MALAYANUS/ (MYCTOPHIDAE, PISCES). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (4): 611-622. 1975. SFA 21(3).

[Inst. Oceanol., Acad. Sci., Moscow, USSR] the development of /Diaphus malayanus/ is described according to material collected in July-September 1969 along the shore of Southeastern Arabia (Arabian Sea).



76-000975 Verigin, B. V.; Makeyeva, A. P.; Shubnikova, N. G. THE MORPHOLOGY OF UNDERYEARLING HYBRIDS OF THE BIGHEAD /ARISTICHTHYS NOBILIS/ AND THE GRASS CARP /CTENOPHARYNGODON IDELLA/. J. Ichthyol. (Engl. Transl. Vopr. Ikhtirol.) 15 (2): 226-231. 1975. SFA 21(3).
 [Dep. Ichthyol., Moscow Univ., USSR] Viable hybrids were obtained and raised to the underyearling stage. A morphological analysis by means of the hybrid index, showed a high degree of intermediacy in several characters.

PHYSIOLOGY

76-000976 Alekseyeva, K. D. PROCEDURE FOR DETERMINATION OF ACTIVE METABOLISM IN THE RANDOM SWIMMING OF YOUNG FISHES. J. Ichthyol. (Engl. Transl. Vopr. Ikhtirol.) 15 (2): 334-337. 1975. SFA 21(3).
 [Inst. Biol. Inland Waters, USSR Acad. Sci., Sevastopol, USSR]

76-000977 Burlakov, A. E. ON THE QUANTITY OF GONADOTROPIC HORMONES IN THE HYPOPHYSIS OF THE CARP, /CYPRINUS CARPIC/. J. Ichthyol. (Engl. Transl. Vopr. Ikhtirol.) 15 (4): 635-644. 1975. SFA 21(3).
 [Dep. Ichthyol., Moscow State Univ., Moscow, USSR] Investigation of the water-soluble fraction of hypophyses of female carp by means of disc-electrophoresis in polyacrylamide gel with subsequent biological testing of the elutes of separate zones of the gel on loaches showed the presence of two protein zones possessing gonadotropic activity. It was found that both gonadotropins are present in the hypophyses of fish in various stages of ripeness, in different quantitative proportions. It has been made clear that the observed change of overall gonadotropic activity of the hypophyses in various stages of ripeness occurs mainly owing to change in the activity of the most electrophoretically mobile gonadotropin. Certain physico-chemical properties of both hormones, purified with the help of disc-electrophoresis and gel-filtration on Sephadex G-75, were studied. It was shown that they have similar molecular weight, but differ by electrophoretic mobility and the spectra of emission.

76-000978 Burns, J. R. THE REPRODUCTIVE CYCLE AND ITS ENVIRONMENTAL CONTROL IN THE PUMPKINSEED, /LEPOMIS GIBBOSUS/ (PISCES: CENTRARCHIDAE). Copeia 1976 (3): 449-455. Aug. 1976. SFA 21(3).

[Dep. Biol., Univ. El Salvador, San Salvador, El Salvador, Central America] The seasonal cycle of gonadal development was studied in pumpkinseed, /Lepomis gibbosus/, subject to natural temperatures and day lengths in a local pond. During late May, 1972, gonadal recrudescence in both males and females occurred, as indicated by an increase in the gonosomatic index and the appearance of spermatocytes in the testes and active vitellogenesis in the ovaries. During this time the pond temperature rose above 12.5 C, while the day length was near 15 hours. Laboratory experiments with fish exposed to controlled temperatures and photoperiods were performed. The results showed that a minimal temperature between 11.5 and 14.0 C was necessary for recrudescence in males, while one between 14.0 and 16.5 C was necessary for the females. However, the seasonal study indicated that the critical temperature for females is probably lower than 14.0 C. The critical photoperiod for both males and females was probably between 12.0 and 13.5 hrs. Since the critical day length was reached sooner than the increase in pond temperature above the critical level, it appears that temperature is the environmental factor controlling the timing of recrudescence in the spring. During the early post-spawning period temperatures and day lengths were still above the

76-000978 CONTINUED

critical levels. However, no renewed gonadal activity was observed at this time, suggesting the existence of a post-spawning refractory period.

76-000979 Cech, J. J., Jr.; Bowell, D. M. VASCULAR CANNULATION METHOD FOR FLATFISHES. Prog. Fish-Cult. 38 (2): 74-75. Apr. 1976. SFA 21(3).

[Div. Wildl. Fish. Biol., Univ. Calif., Davis 95616] With the use of an operating table for fish and a blunted cannulation needle, polyethylene cannulae can be inserted into the caudal artery (dorsal aorta) and caudal vein of flatfishes weighing more than 0.5 kg. After the skin is pierced with a sharp hypodermic needle, the 18-gauge, thin-wall cannulation needle containing the beveled cannula is inserted to a hemal arch. The saline-filled cannula is pushed into one of the vessels; when the cannulation needle has been withdrawn, the cannula is anchored with a single skin suture. The cannula for the other vessel is then similarly implanted and secured. The surgical procedure requires neither anesthesia nor incisions and apparently does not adversely affect the test animals.

76-000980 Chernyshov, V. I.; Magonedov, S. K. ALTERATION IN THE TOXICITY OF TISSUE LIPIDS WITH THE ADAPTATION OF FISHES TO OSMOTIC PRESSURE CHANGES IN THE ENVIRONMENT. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (2): 346-349. 1975. SFA 21(3).

[Dep. Biophysics, Moscow Univ., Moscow, USSR]

76-000981 Chervinski, J.; Lahav, M. THE EFFECT OF EXPOSURE TO LOW TEMPERATURE ON FINGERLINGS OF LOCAL TILAPIA (/TILAPIA AUREA/) (STEINDACHNER) AND IMPORTED TILAPIA (/TILAPIA VULCANI/) (TREWAVAS) AND /TILAPIA NILOTICA/ (LINNE) IN ISRAEL. Bamidgah 28 (1/2): 25-29. 1976. SFA 21(3).

[Fish Aquacult. Res. Stn., Dor, Israel]

76-000982 Davis, K. B.; Simco, B. A. DIURNAL MEASUREMENTS OF PLASMA CHLORIDE IN CATFISH. Copeia 1976 (3): 608-609. Aug. 1976. SFA 21(3)

[Dep. Biol., Ecol. Res. Cent., Memphis State Univ., Memphis, TN 38152]

76-000983 DeLaney, R. G.; Shub, C.; Fishman, A. P. HEMATOLOGIC OBSERVATIONS ON THE AQUATIC AND ESTIVATING AFRICAN LUNGFISH, /PROTOPTERUS AETHIOPICUS/. Copeia 1976 (3): 423-434. Aug. 1976. SFA 21(3).

[Dep. Med., Univ. Pa., Philadelphia 19104] Hematologic changes during estivation of /Protopterus aethiopicus/ were characterized. The erythrocyte count increased from an aquatic value of $63,000 \pm 6,600$ S.D./mm³ to $114,000/\text{mm}^3$ within one month and remained between 108-116,000 RBC/mm³ throughout the 13 months of observation. There was a concomitant increase in the hemoglobin concentration from 7.4 ± 0.8 S.D. g percent to 11-13.5 g percent, and the relative amounts of each of the four electrophoretically separated hemoglobin fractions changed during estivation. The leukocyte count tripled during the first month of estivation from $1,570 \pm 198$ S.D./mm³ to $4,511/\text{mm}^3$ and then diminished to the normal aquatic range during the 3rd to 13th month. Differential counts revealed a new granulocyte, designated the meta-eosinophil, which appeared in the peripheral blood within 1 week and persisted throughout the subsequent 13 months estivation. The leukocyte response of estivating lungfish to infection appears to

76-000983 CONTINUED

differ from that of aquatic lungfish.

76-000984 Dolinin, V. A. MECHANISMS OF ENSURING GAS EXCHANGE IN FISH J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (4): 649-657. 1975. SFA 21(3).

[Inst. Physiol., Acad. Sci., Novosibirsk, USSR] The absolute values and the character of change in the basic parameters of the respirator function of the ide, *Leuciscus idus*, and northern pike, *Esox lucius*, with change of the oxygen concentration and motor activity of the fish under conditons of constant, artificially-fixed volume of ventilation were determined. Comparison of the results with the data characteristic for intact fish permitted a conclusion about the mechanism of ensuring the necessary intensity of respiration in these fishes and about the causes of its disruption under experimental conditions.

76-000985 El-Shamy, F. M. ANALYSES OF GASTRIC EMPTYING IN BLUEGILL (*LEPOMIS MACROCHIRUS*). J. Fish. Res. Board Can. 33 (7): 1630-1633. July 1976. In English with French summ. SFA 21(3).

[Lawler, Matusky and Skelly Eng., Tappan, NY 10983] Bluegill (*Lepomis macrochirus*) fed a single meal averaging 111.6 mg dry wt (2.19 percent body wt on a wet fish and food basis) showed an average of 60 mg (54 percent) of the meal remaining after 8 h of digestion compared to 71 mg (59 percent) of an equivalent amount of food (119.6 mg or 2.04 percent body wt) fed in two consecutive meals. Fish fed a single meal averaging 167.2 mg (2.74 percent body wt) showed an average of 41 percent of the meal remaining 12 h after feeding, while fish fed three consecutive meals totaling 140.3 mg (2.51 percent body wt), showed an average of 47 percent of the food intake remaining 12 h after they were first fed. Two statistical models--an exponential and a multiple regression--relating food digested to meal size and time of feeding were developed. Both statistical models, when based on results of fish fed single meals, failed to predict values comparable to those observed for bluegill fed multiple meals.

76-000986 Guest, W. C.; Avault, J. W., Jr.; Roussel, J. D. A SPERMATOLOGY STUDY OF CHANNEL CATFISH, *ICTALURUS PUNCTATUS*. Trans. Am. Fish. Soc. 105 (3): 463-468. May 1976. SFA 21(3).

[Texas Parks Wildl. Dep., Heart of the Hills Res. Stn., Junction Star Route, Box 62, Ingram, TX 78025] Forty male channel catfish (*Ictalurus punctatus*) of two age groups and two stocks (domestic and wild) were compared in an experiment to study morphological and physiological characteristics of their testes and sperm cells from May through October. The gonosomatic index for 36 normal catfish examined averaged 0.25 percent. An average of 82.7 percent spermatozoa were alive with an average motility score of 2.96. These fish had an average gonadal sperm concentration of 7.1×10^9 spermatozoa per g wet testicular tissue. The testes were found to be composed of 2/3 spermatogenic and 1/3 glandular tissue. There were no morphological changes observed in the characteristics of the spermatogenic tissue during the period of study. The 3-year-old fish were consistently larger than the 2-year-olds, and the domestic fish were larger than the wild stock in each age group, which probably caused most of the differences in characteristics when comparisons were made.

76-000987 Hauser, W. J. A BLIND CHANNEL CATFISH, *ICTALURUS PUNCTATUS*/. Copeia 1976 (3): 612-613. Aug. 1976. SFA 21(3).
[Imperial Valley Field Stn., 1004 E. Holton Rd., El Centro, CA 92243]

76-000988 Hickey, C. R., Jr. FISH HEMATOLOGY, ITS USES AND SIGNIFICANCE. N. Y. Fish Game J. 23 (2): 170-175. July 1976. SFA 21(3).

[U.S. Nuclear Regulatory Comm., Washington, DC 20555] Fish hematology is a useful tool of the ichthyologist and fishery biologist as an indicator of the physiological condition of experimental and hatchery fish stocks. It may be especially useful in assessing the status of nutrition, diseases and parasites, and stress due to changing environmental conditions. There is a need for determining normal hematological values under a wide variety of natural and experimental conditions, as these normal values must be known in order to recognize a pathological state. Also, procedures and techniques in hematological investigation, as well as methods for reporting, need to be more thoroughly standardized.

76-000989 Higgs, D. A.; Donaldson, E. M.; Dye, H. M.; McBride, J. R. INFLUENCE OF BOVINE GROWTH HORMONE AND L-THYROXINE ON GROWTH, MUSCLE COMPOSITION, AND HISTOLOGICAL STRUCTURE OF THE GONADS, THYROID, PANCREAS, AND PITUITARY OF COHO SALMON (*ONCORHYNCHUS KISUTCH*/). J. Fish. Res. Board Can. 33 (7): 1585-1603. July 1976. In English with French summ. SFA 21(3).

[Dep. Environ., Fish. Mar. Serv., West Vancouver, BC V7V 1N6, Canada] Doses of Bovine growth hormone (5, 10, 20, 30, or 90 ug bGH/g body wt) and L-thyroxine (0.5, 5, or 30 ug T(4)/g) were administered over a period of 84 days (phase I) either by injection or by hormone cholesterol implants into the muscle. Administration frequency of bGH and T(4) was such that fish theoretically received either 10 or 30 ug bGH/g per wk or 1 or 10 ug T(4)/g per wk. After cessation of treatment the fish were observed for an additional 84 days (phase II). During phase I, growth rates (weight) for bGH fish (2.0-2.4 percent per day) and for T(4) fish (0.97-1.1 percent per day) were significantly higher than those of control fish (0.42-0.59 percent per day). Among bGH fish, dorsal musculature injection was significantly more effective than intraperitoneal injection. Increases in weight above control for bGH fish at 84 days ranged from 220 to 369 percent. Those for T(4) fish extended from 47 to 78 percent. In phase II, control fish growth rates were higher (0.61-0.67 percent per day) than those for bGH fish (0.47-0.57 percent per day) and T(4) fish (0.32-0.44 percent per day). Administration of bGH and T(4) (high dose) caused a progressive decline in condition factor of fish from the control range. This trend was stopped and reversed in phase II. At 84 days, generally no significant differences were detected among groups for percentages of muscle water. However, some groups had significantly higher (bGH) and others lower (T(4)) percentages of muscle protein relative to those of control fish. Also, significant increases (T(4)) and decreases (bGH) in muscle lipid percentages were found. Hormone treatment altered the histological structure of the ovary, thyroid, exocrine (T(4)) and endocrine (bGH) pancreas, and somatotrop cells (T(4)) of the pituitary. A poor growth response was noted for two groups of coho administered bGH after acclimation to sea water. --From abstr.

76-000990 Hunn, J. B. INORGANIC COMPOSITION OF GALLELACER BILE FROM FRESHWATER FISHES. *Copeia* 1976 (3): 602-605. Aug. 1976. SFA 21 (3).

[U.S. FWS, Fish Control Lab., P.O. Box 862, La Crosse, WI 54601]

76-000991 James, G. D. EGGS AND LARVAE OF THE TREVALLY /CARANX GEORGIANUS/ (TELEOSTEI: CARANGIDAE). *N. Z. J. Mar. Freshwater Res.* 10 (2): 301-310. June 1976. SFA 21 (3).

[Fish. Res. Div., Minist. Agric. Fish., P.O. Box 19062, Wellington, New Zealand] The development and distinctive features of the eggs and larvae of /*Caranx georgianus*/ Cuvier, 1833 are described. Diameters of the egg and oil globule range between 0.76 mm and 0.86 mm, and 0.20 mm and 0.25 mm respectively. At 21°C, the eggs hatched approximately 28 h after fertilisation.

76-000992 Klyashtorin, L. B. THE SENSITIVITY OF YOUNG SALMONIDAE TO OXYGEN DEFICIENCY. *J. Ichthyol.* (Engl. Transl. *Vopr. Ikhtiocl.*) 15 (2): 337-341. 1975. SFA 21 (3).

[VNIRO, Moscow, USSR]

76-000993 Koenig, C. C.; Livingston, R. J. THE EMBRYOLOGICAL DEVELOPMENT OF DIAMOND KILLIFISH (/ADINIA XENICA/). *Copeia* 1976 (3): 435-445. Aug. 1976. SFA 21 (3).

[Grice Mar. Biol. Lab., Coll. Charleston, Charleston, SC 29412] Egg production has been induced in mature females of the estuarine cyprinodont /*Adinia xenica*/ throughout the year under controlled conditions of temperature (27°C) and day length (14 hrs). Adults are hardy and easily maintained in the laboratory. Gravid females produce from 15 to 40 fertilizable eggs. Eggs are large (2mm dia), demersal and possess a transparent chorion. Development has been divided into 36 stages. Development is similar to the development of /*Fundulus heteroclitus*/ except that /*Adinia*/ is in a more advanced condition upon earliest hatching. Delayed hatching may occur under certain incubation conditions.

76-000994 Komarov, I. P.; Komarov, P. V.; Deniskin, P. G. A STUDY OF BLOOD SERUM PROTEIN FRACTIONS IN SOME CYPRINIDAE OF THE VOLGA DELTA. *J. Ichthyol.* (Engl. Transl. *Vopr. Ikhtiocl.*) 15 (2): 344-346. 1975. SFA 21 (3).

[Astrakhan Tech. Inst. Fish. Fish Farm., Astrakhan, USSR]

76-000995 Kucherova, F. N.; Golubev, S. N. MINERAL COMPOSITION OF THE SEXUAL PRODUCTS OF THE SILVER CARP, /HYPOPHthalmichthys molitrix/. *J. Ichthyol.* (Engl. Transl. *Vopr. Ikhtiocl.*) 15 (4): 670-672. 1975. SFA 21 (3).

[Rostov-on-Don State Univ., USSR]

76-000996 Marusov, Ye. A. REACTIONS OF YOUNG SALMONIDS TO CERTAIN NATURAL CHEMICAL STIMULI. *J. Ichthyol.* (Engl. Transl. *Vopr. Ikhtiocl.*) 15 (2): 341-343. 1975. SFA 21 (3).

[Dep. Ichthyol., Moscow Univ., Moscow, USSR]

76-000997 Mezhnin, F. I. THE INTERRENAL TISSUE OF THE BURBOT, /LOTA LOTA/, DURING SPAWNING. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (2): 279-284. 1975. SFA 21(3).

[USSR Acad. Sci., Borok, USSR] The close interdependence between interrenal tissue (the homolog of the suprarenal cortex in mammals) and the gonads in the burbot, /Lota lota/, is demonstrated. Toward spawning time, the interrenal tissue becomes strongly hypertrophied. The volume of the cells and nuclei increases, pointing to the intensification of their functional activity. The chromaffin tissue hypertrophies less than the interrenal tissue. After spawning, degeneration of the previously hypertrophied tissue begins. The tissue undergoes lysis, the cells decrease in size and break up, the interrenal tissue is replaced by porous connective tissue. Towards stage II of maturity the interrenal tissue assumes its "original" state. Subsequently, hypertrophy of the interrenal tissue begins simultaneously with the maturation of the sexual products.

76-000998 Pardo, R. J.; de Vlaming, V. L. IN VIVO AND IN VITRO EFFECTS OF PROLACTIN ON LIPID METABOLISM IN THE CYPRINID TELEOST /NOTEMIGONUS CRYSOLEUCAS/. Copeia 1976 (3): 563-573. Aug. 1976. SFA 21(3).

[Dep. Zool., Marquette Univ., Milwaukee, WI 53233] Ovine prolactin has a marked effect on lipid deposition in the cyprinid teleost /Notemigonus crysoleucas/. Prolactin injections early in the light phase of a long photoperiod (15 C or 24 C) decrease body lipids. Injections of this hormone 10 hours after the onset of a long photoperiod increase body lipids in 15 C acclimated fish, but do not alter fat deposits in 24 C acclimated animals. Experiments designed to determine the in vitro effects of prolactin on lipid metabolism gave variable results. Some of our data suggest that lipid metabolism in /Notemigonus/ liver tissue is influenced by prolactin and that the response varies with acclimation conditions of the fish and with the time of day that the liver is removed and put into incubation.

76-000999 Rusaouen, M. THE DOGFISH SHELL GLAND, A HISTOCHEMICAL STUDY. J. Exp. Mar. Biol. Ecol. 23 (3): 267-283. Sept. 1976. SFA 21(3).

[Lab. Cytol., Univ. Paris VI, Quai St., Bernard, Paris, France] On the basis of previous work and new histochemical results, the dogfish nidamental gland is divided into six distinct zones. Several neutral or acid mucopolysaccharides are present; the latter are more or less sulphated. Various proteins including a phenolic glycoprotein tanned by a phenolase and a peroxidase, a sulphur containing protein, and collagenous protein are also present. The connection between the zones of secretion and the layers of the egg-shell layers is discussed.

76-001000 Santerre, M. T. EFFECTS OF TEMPERATURE AND SALINITY ON THE EGGS AND EARLY LARVAE OF /CARANX MATE/ (CUV. & VALENC.) (PISCES: CARANGIDAE) IN HAWAII. J. Exp. Mar. Biol. Ecol. 21 (1): 51-68. Jan. 1976. SFA 21(3).

[Hawaii Inst. Mar. Biol., Kaneohe] Eggs and larvae of the carangid fish, /Caranx mate/ (Cur. & Valenc.), were incubated at various temperature (17.2 to 33.1 °C) and salinity (10 to 42‰) combinations in five experiments. The following rates were directly proportional to temperature: embryonic development, yolk absorption, eye and jaw development, and increase in length. Unfed /C. mate/ larvae attained a maximum size at 25 °C and 20‰. Eyes and jaws of larvae were functional by the end of the yolk sac stage at all temperature and salinity levels tested. Hatching success and larval survival at the end of the yolk sac stage were generally greater than 50 percent

76-001000 CCNTINUED

between 22 ° and 32 °C. Hatching success and larval survival at the end of the yolk sac stage were reduced at salinity extremes, especially in low temperature-low salinity and high temperature-high salinity combinations. The frequency of morphological abnormalities was also high at extreme temperatures and salinities. The incipient upper thermal TL(m) for unfed /C. mate/ larvae acclimated to 23.8 °C increased from 31.5 °C for newly hatched larvae, to 34.2 °C for 72 h larvae, but decreased to 32.0 °C for starving larvae after the exhaustion of the yolk supply.

76-001001 Sharipov, K. O. IMMUNE SEROLOGICAL FEATURES OF THE BLACK SEA SALMON, /*SALMO TRUTTA LABRAX*/, AND THE BROOK TROUT, /*S. TRUTTA LABRAX*/ MORPHA /*FARIO*/. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (2): 328-330. 1975. SFA 21(3).

[Vet. Res. Inst., Dagestan, USSR]

76-001002 Sherstnyeva, T. A. THE DYNAMICS OF THE INDICATORS OF CARBOHYDRATE EXCHANGE IN THE CARP /*CYPRINUS CARPIO*/ DURING OVER-WINTERING. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (2): 290-298. 1975. SFA 21(3).

[GosNIORKh, Leningrad, USSR] The dynamics are considered of the sugar and lactic acid content in blood serum and of glycogen content in the liver and in white and red muscles in carp underyearlings and yearlings of various size during overwintering.

76-001003 Somkina, N. V. CERTAIN FEATURES OF METABOLISM IN THE BRAIN OF THE STURGEON, /*ACIPENSER GULDENSTADTI*/ IN EARLY ONTOGENY AND UNDER THE INFLUENCE OF SALINITY. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (4): 688-691. 1975. SFA 21(3).

[AzNIRKh, Rostov-on-Don, USSR]

76-001004 Stelbov, A. Ya. THE EFFECT OF MEASURED MUSCULAR LOADS ON THE METABOLIC RATE OF THE BAIKAL GRAYLING, /*THYMALLUS ARCTICUS BAIKALENSIS*/. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (2): 298-303. 1975. SFA 21(3).

[USSR Acad. Sci., Novosibirsk, USSR] The respiratory metabolism in the Baikal grayling was studied in a state of rest and with muscular loads under conditions of a change in water temperature. Oxygen consumption in the species studied depends to some extent on water temperature and swimming speed. Cruising motion in fishes is characteristic of migratory travel and accompanied by a steady metabolic level. With intensive short-term loads, an increase in oxygen consumption and an oxygen debt is observed, limiting the possibility of protracted swimming.

76-001005 Sytina, L. A. DIVERGENCE OF FEATURES IN THE COURSE OF EARLY ONTOGENETIC DEVELOPMENT OF THE LARVAE OF CLOSELY RELATED SPECIES OF STURGEONS. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (4): 594-606. 1975. SFA 21(3).

[IEMEZh AN SSSR, Moscow, USSR] The characteristics of distance receptors (organs of olfaction, vision and statoacoustics) were investigated in different species of sturgeons in similar stages of ontogeny. It was determined that divergence in the development of sensory organs occurs even in the earliest stages of ontogeny. It is specified by the morpho-ecological peculiarities of the species and is based on differences in the rate of their growth and differentiation that are specific for each species. Acceleration or slowing of development of a receptor organ is determined by its function for

76-001005 CONTINUED
orientation in each stage of ontogeny.

76-001006 Theisen, B. THE OLFACTORY SYSTEM IN THE PACIFIC HAGFISHES /EPTATRETUS STOUTII/, /EPTATRETUS DEANI/, AND /MYXINE CIRCIFRONS/. Acta Zool. 57 (3): 167-173. 1976. SFA 21(3).

[Inst. Comp. Anat., Univ. Copenhagen, Denmark] In front of the olfactory organ in the northeastern Pacific hagfishes there is a valve that may function to direct water in between the olfactory laminae. In /Myxine circifrons/ the well developed valve is supposed to act alone, whereas the smaller valve in the two species of /Eptatretus/ studied is supposed to act together with the horizontal extensions of the median olfactory lamina. No significant differences were found between the investigated species by ultrastructural examination. In the olfactory epithelium the supporting cells are provided with microvilli and generally contain a great amount of light secretory granules. Both ciliated olfactory receptor cells and microvillous olfactory receptor cells are present. The cilia show a 9+0 arrangement of the microtubules with a tendency for a dislocation of one pair of the microtubules toward the center of the cilium. These remarkable features of the olfactory receptor cells, not yet seen in other vertebrates, appear to be a character common to the myxincid cyclostomes.--From abstr.

76-001007 Tsuneki, K. EFFECTS OF ESTRADIOL AND TESTOSTERONE IN THE HAGFISH /EPTATRETUS BURGERI/. Acta Zool. 57 (3): 137-146. 1976. SFA 21(3).

[Misaki Mar. Biol. Stn., Univ. Tokyo, Miura-shi, Kanagawa-ken, Japan] Effects of exogenous estradiol and testosterone on the gonad and pituitary were examined in the hagfish. Estradiol caused degeneration of the ovary. Testosterone had no effect on the ovary. Neither steroid had a significant effect on the testis. Neither estradiol nor testosterone provoked a conspicuous change in adenohypophysial cells. Therefore, a feedback mechanism between gonadal steroids and gonadotropin either does not exist or plays a very minor role. The degeneration of the ovary may be due to a pharmacological effect of estradiol.

76-001008 Vechkanov, V. S. INTENSITY OF RESPIRATION OF THE SILVER CARP, /HYPOPHthalmichthys molitrix/. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (4): 645-649. 1975. SFA 21(3).

[Dep. Ichthyol., Moscow State Univ., Moscow, USSR] Values are presented of the intensity of respiration of the silver carp, /Hypophthalmichthys molitrix/, obtained in experiments using a method of closed vessels. Dependence of the magnitude of respiration on the weight of individuals of this species is shown. Variation of the values of the parameters in equations describing the connection between respiration and weight with change of water temperature and the weight interval of the studied fish is noted.



GENETICS, VARIATION STUDIES AND HYBRIDIZATION

76-001009 Pantelouris, E. M. ASPARTATE AMINOTRANSFERASE VARIATION IN THE ATLANTIC EEL. J. Exp. Mar. Biol. Ecol. 22 (2): 123-130. May 1976. SFA 21(3).

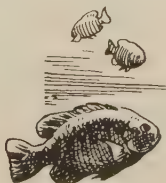
[Dep. Biol, Univ. Strathclyde, Glasgow, Scotland] Electrophoretic patterns of aspartate aminotransferase (AAT) in the liver of yellow Atlantic eels (*Anguilla anguilla*/ L. and *A. rostrata*/ Le Sueur L.) are complex. Four zones of activity are separated, one being cathodal and corresponding to mitochondrial AAT. The two fastest zones appear to repeat each other in most, but not all, cases. This raises the possibility of duplicate but independently mutating loci. A hypothesis is put forward about the adaptive requirement of complex AAT supplies in anadromous and catadromous fish. Comparison of American and European samples did not produce decisive results on the issue of two as opposed to one gene pools in the Atlantic eel.

76-001010 Pantelouris, E. M.; Arnason, A.; Bumpus, R. NEW OBSERVATIONS ON ESTERASE VARIATION IN THE ATLANTIC EEL. J. Exp. Mar. Biol. Ecol. 22 (2): 113-121. May 1976. SFA 21(3).

[Biol. Dep., Univ. Strathclyde, Glasgow, Scotland] Two American and eight European collections of silver eels were examined electrophoretically for variations in their liver esterases. Considering the results together with those obtained previously, it was confirmed that there is large variation in phenotype frequencies within both the eastern and the western Atlantic populations. Such quantitative data are, therefore, unlikely to resolve the question whether the two populations are produced from one or from two gene pools. The concept of separate gene pools, /i.e./, the classical two-species theory, is supported by certain differences in the esterase patterns which are not quantitative but consist in the complete absence from the one but presence in the other population of particular electrophoretic bands, or particular molecular properties reflected in consistent dissimilarities of electrophoretic mobility. A system of esterases is described which is shared by silver eel liver and whole homogenate of elvers. This system could be used in comparing phenotype frequencies in elvers and adult eels, and thus detect changes in the freshwater stages caused by differential selection.

76-001011 Shpak, V. M. MORPHOMETRIC DESCRIPTION OF THE "SOUTHERN PUTASSU" /*Micromesistius australis*/ NORMAN FROM THE AREA OF THE NEW ZEALAND PLATEAU WITH NOTES ON THE DIAGNOSIS OF THE GENUS /*MICROMESISTIUS*/ GILL. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (2): 175-181. 1975. SFA 21(3).

[TINRO, Vladivostok, USSR] The population structure of the "southern Putassu" /*Micromesistius australis*/ Norman from the area of the New Zealand Plateau is studied. Sexual dimorphism is weakly expressed. Morphological and meristic characters are subject to considerable age-related variability. The genus /*Micromesistius*/ Gill, 1864, is more accurately diagnosed; there are few pyloric caeca (9-13),



BEHAVIOR

- 76-001012 Breder, C. M., Jr. FISH SCHOOLS AS OPERATIONAL STRUCTURES. NCAA Fish. Bull. 74 (3): 471-502. July 1976. SFA 21(3).
 [Mote Mar. Lab., 9501 Blind Pass Rd., Sarasota, FL 33581] The interaction of a space lattice, vortex trails, and the lubricity of fish surface mucus is shown to be important to the operation and structure of fish schools and significant in terms of locomotor efficiency. This is independent of the various interpretations of possible survival values, protection from predation, and similar ideas--all of which are extremely difficult to prove, even if valid. A single type of space lattice is shown to approximate the arrangement of fishes in a school on the basis of geometrical reasoning. This is supported by empirical data. The vortex trails left by each fish, when the fishes are deployed according to the "fish school" lattice, lead each following fish into a series of vortices at a point where the water flow is traveling in the direction in which they are swimming. The lubricity of the mucus-water mixture that the fish ahead leaves in its vortices decreases the drag on the following fish. The advantages of the regimented life in a school, as against the freedom of action common to the more or less solitary life, are evidently related to the effectiveness of the drag-reducing mucus in the vortices. The fishes with the least effective mucus appear to take advantage of the schooling life while those with the most effective mucus are more likely to be solitary.
- 76-001013 Cheetham, J. L.; Garten, C. T., Jr.; King, C. L.; Smith, M. H. TEMPERATURE TOLERANCE AND PREFERENCE OF IMMATURE CHANNEL CATFISH (*ICTALURUS PUNCTATUS*). Copeia 1976 (3): 609-612. Aug. 1976. SFA 21(3).
 [Savannah River Ecol. Lab., Drawer E, Aiken, SC 29801]
- 76-001014 Coutant, C. C. RESPONSES OF BASS TO NATURAL AND ARTIFICIAL TEMPERATURE REGIMES. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 272-285. 1975. SFA 21(3).
 [Environ. Sci. Div., Oak Ridge Natl. Lab., Oak Ridge, TN]
- 76-001015 Darkov, A. A. BEHAVIORAL REACTIONS OF SCHOOLING FISHES IN INDIVIDUALS OF THE SAME SPECIES AND THE QUESTION OF SCHOOL FORMATION. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (4): 691-694. 1975. SFA 21(3).
 [IZMEZh, Moscow, USSR]
- 76-001016 Eggers, D. M. THEORETICAL EFFECT OF SCHOOLING BY PLANKTIVOROUS FISH PREDATORS ON RATE OF PREY CONSUMPTION. J. Fish. Res. Board Can. 33 (9): 1964-1971. Sept. 1976. In English with French summary. SFA 21(3).
 [Coll. Fish., Fish. Res. Inst., Univ. Wash., Seattle 98195]
 Effect of schooling on the rate of prey consumption by planktivorous fish is deduced by extending the Holling disk equation (i.e. the rate of prey consumption by solitary feeding fishes can be expressed by the Holling disk equation) to account for lateral visual-field overlap and reduction of prey density due to removal of prey by forward-occurring members of the school. Effect of schooling is expressed as the rate of prey consumption per member of the school relative to that by a solitary individual. This

76-001016 CONTINUED

study suggests that schooling of predators occurs at the expense of prey consumption. Cost of schooling is reduced if prey densities are high, if distance between members is high, or if school size is small. There may be some advantage to schooling when prey have a clumped distribution.

76-001017 Moller, P. ELECTRIC SIGNALS AND SCHOOLING BEHAVIOR IN A WEAKLY ELECTRIC FISH, /MARCUSENIUS CYPRINOIDES/ L. (MORMYRIFORMES). Science 193 (4254): 697-699. Aug. 1976. SFA 21(3).

[Dep. Psychol., Hunter Coll., New York, NY 10021] Field recordings of electric organ discharges and catches of /Marcusenius cyprinoides/ showed that these electric fish form groups and move about in schools. The role of electric organ discharges in group cohesion was investigated by comparing interactions in groups of intact and operated, electrically silent fish. The absence of electric organ discharges reduced locomotor activity and resulted in the disappearance of two behaviors: parallel lineup and single file swimming. Electric signals are considered part of a schooling mechanism that aids the fish in maintaining group cohesion in their turbid environment and during migration at night.

76-001018 Muller, R.; Fry, F. E. J. PREFERRED TEMPERATURE OF FISH: A NEW METHOD. J. Fish. Res. Board Can. 33 (8): 1815-1817. Aug. 1976. In English with French summ. SFA 21(3).

[Swiss Fed. Inst. Water Resour. Water Pollut. Control, Fish. Div., CH-8600, Dübendorf, Switzerland] A simple apparatus for establishing a short, steep vertical temperature gradient is described. The preferred temperature is found by determining calorimetrically the mean body temperature of fish in such a gradient. Preferred temperatures at various acclimation temperatures for a sample of young pumpkinseed, /Lepomis gibbosus/, are given.

76-001019 Reynolds, W. W.; Casterlin, M. E. ACTIVITY RHYTHMS AND LIGHT INTENSITY PREFERENCES OF /MICROPTERUS SALMOIDES/ AND /M. DOLOMIEUI/. Trans. Am. Fish. Soc. 105 (3): 400-403. May 1976. SFA 21(3).

[Dep. Biol., Pa. State Univ., Wilkes-Barre 18708] Activity rhythms and light intensity Preferences of largemouth (/Micropterus salmoides/) and smallmouth (/M. dolomieu/) black basses were investigated in laboratory experiments designed to elucidate aspects of niche separation between these sympatric congeners. Both species exhibited crepuscular activity, but /M. salmoides/ also showed a mid-day activity peak. /M. dolomieu/ avoided bright light, and their peak activity periods occurred at the beginning and end of the dark periods. Activity of /M. salmoides/ was much more depressed during the dark periods, and rose sharply at the onset of light periods. Activity records in constant light conditions showed these activity rhythms to be endogenous.

76-001020 Reynolds, W. W.; Casterlin, M. E. LOCOMOTOR ACTIVITY RHYTHMS IN THE BLUEGILL SUNFISH, /LEPOMIS MACROCHIRUS/. Am. Midl. Nat. 96 (1): 221-225. July 1976. SFA 21(3).

[Dep. Biol., Pa. State Univ., Wilkes-Barre, 18708] Locomotor activity of bluegill sunfish was monitored electronically as the fish moved between the chambers of an experimental tank. Phototransistors and associated circuitry permitted the fish to control water temperature and/or lights independently along two axes, with no prior training; alternatively, these variables could be exogenously controlled by thermostats and timers. The fish exhibited an

76-001020 CONTINUED

endogenous, diurnal (60-70 percent of total 24-hr activity), locomotor activity pattern which persisted in the absence of an exogenous light cycle (DD), or when the fish controlled the lights, and was unaffected by temperature (17 or 31 C). The diurnal activity pattern persisted when fish controlled the water temperature (mean = 31 C both day and night), indicating that thermoregulatory movements at night did not disrupt the rhythm seen at constant fixed temperatures.

76-001021 Spieler, R. E.; Meier, A. H.; Loesch, H. C. PHOTOPERIODIC EFFECTS ON SALINITY SELECTION IN THE GULF KILLIFISH, /FUNDULUS GRANDIS/. Copeia 1976 (3): 605-608. Aug. 1976. SFA 21(3).

[Dep. Mar. Sci., La. State Univ., Baton Rouge 70803]

LIFE HISTORIES-GENERAL WORKS

76-001022 Il'yasova, Z. Ya. SOME PROBLEMS OF THE ECOLOGY OF THE SARYCHILEK MARINKA /SCHIZOTHORAX INTERMEDIUS EURYCEPHALUS/. J. Ichthyol. (Engl. Transl. Vopr. Ikhtirol.) 15 (2): 202-208. 1975. SFA 21(3).

[Tashkent Univ., USSR] Data are given on the ecology of the juvenile and adult Sarychilek marinka /Schizothorax intermedius eurycephalus/. This species is represented by two morphs (typical mouth and thick-lipped) and two ecological forms (lake and river).

76-001023 Abdurakhmanov, Yu. A. TRANSFORMATION OF THE DIADROMOUS KURA SHEMAYA /CHALCALBURNUS CHALCOIDES/ INTO A LAND-LOCKED POPULATION IN THE MINGECHAUR RESERVOIR. J. Ichthyol. (Engl. Transl. Vopr. Ikhtirol.) 15 (2): 189-196. 1975. SFA 21(3).

[Azerbaijdzhan SSR Acad. Sci., Baku, USSR] The diadromous Kura shemaya /Chalcalburnus chalcoides/ in Mingechaur reservoir has become land-locked and is distinguished by a number of biological features. Data are given on the alteration in the structure of the population, on the growth, fecundity and reproduction, and on the ecology of the young.

76-001024 Bass, D. G., Jr.; Hitt, V. G. ECOLOGICAL ASPECTS OF THE REDBREAST SUNFISH, /LEPOMIS AURATUS/, IN FLORIDA. Proc. Annu. Conf. Southeast. Asscc. Game Fish Comm. 28: 296-307. 1975. SFA 21(3).

[Fla. Game Fresh Water Fish Comm., Rt. 7, Box 102, Lake City 32055] An important element of the ichthyofauna of warmwater streams of the southeastern United States, the redbreast sunfish is the dominant species of the lower Suwannee and lower Santa Fe Rivers in Florida. Insects formed the bulk of the diet of both populations though opportunistic feeding is suggested by the wide variety of organisms taken. Spawning occurs from April through October, with a peak in late spring and summer. Fecundity ranged from 942 to 9968 ova per fish. Mean condition factor (K) was higher for Santa Fe redbreasts than for Suwannee specimens. Length-weight relationships for Santa Fe fish were $\log W = -4.20 + 2.89 (\log L)$ and $\log W = -4.06 + 2.81 (\log L)$.

76-001025 Bowering, W. R. DISTRIBUTION, AGE AND GROWTH, AND SEXUAL MATURITY OF WITCH FLOUNDER (/GLYPTOCEPHALUS CYNCGLOSSUS/) IN NEWFOUNDLAND WATERS. J. Fish. Res. Board Can. 33 (7): 1574-1584. July 1976. In English with French summ. SFA 21(3).

[Dep. Environ., Fish. Mar. Serv., Biol. Stn., St. John's, NF A1C 1A1, Canada] Witch flounder (/Glyptocephalus cynoglossus/) were caught from the Hawke Channel to the southern edge of the Grand Bank and west to the Scotian Shelf and the Gulf of St. Lawrence. Although the largest catches were taken at 2-6 C and 185-370 m, witch flounder were found at temperatures ranging from -1 to 10 C and depths of 20-870 m. Witch flounder of the Northeast Newfoundland Shelf were largest and those of the Gulf of St. Lawrence smallest at comparable ages, with growth rates for the east coast of Newfoundland being faster than most other areas. Age and length at 50 percent sexual maturity ranged from 4.20 to 5.59 yr and 25 to 30 cm for males, and from 8.42 to 10.21 yr and 40 to 50 cm for females.

76-001026 Chew, R. L. THE FLORIDA LARGEMOUTH BASS. IN H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 450-458. 1975. SFA 21(3).

[Texas Parks Wildl., Austin 78701]

76-001027 Coble, D. W. SMALLMOUTH BASS. IN H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 21-33. 1975. SFA 21(3).

[Coop. Fish. Res. Unit., Univ. Wis., Stevens Point 54481]

76-001028 Craig, P. C.; Wells, J. LIFE HISTORY NOTES FOR A POPULATION OF SLIMY SCULPIN (/COTTUS COGNATUS/) IN AN ALASKAN ARCTIC STREAM. J. Fish. Res. Board Can. 33 (7): 1639-1642. July 1976. In English with French summ. SFA 21(3).

[53 Howard Ave., Nanaimo, BC V9R 3P9, Canada] The distribution of a slow-growing population of slimy sculpin (/Cottus cognatus/) extends farther than most fishes into the headwaters of the Chandalar River, Yukon River drainage. The maximum observed age was 7 by which time the fish averaged only 101 mm in length. Most sculpin matured at age 4. The spawning season appeared to be shortly after spring breakup (late May). Fecundity averaged 206 eggs (range 59-339 eggs). The fish fed almost exclusively on stream benthos, chironomid larvae being the most common food item.

76-001029 Druzhinin, A. D. SOME DATA ON SPARID FISHES (FAM. SPARIDAE) OF THE GULF OF ADEN REGION. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (4): 531-541. 1975. SFA 21(3).

[VNIRO, Mosccw, USSR] Data are presented on the distribution, length, weight, age, growth rate, condition of the gonads, fatness, food and catches of 5 species of sparid fishes: /Argyrops spinifer/ (Forsk.), /A. filamentosus/ (Val.), /Pagellus natalensis/ Steindachner, /Cheimerius nufar/ (Val.), /Acanthopagrus bifasciatus/ (Forsk.).

76-001030 Elder, R. D. STUDIES ON AGE AND GROWTH, REPRODUCTION, AND POPULATION DYNAMICS OF RED GURNARD, /CHELIDONICHTHYS DUMU/ (LESSON AND GARNOT), IN THE HAURAKI GULF, NEW ZEALAND. N. Z. Minist. Agric. Fish. Fish. Res. Bull. no. 12. 77p. 1976. SFA 21(3).

[Fish Res. Div., Minist. Agric. Fish., Wellington, New Zealand]

76-001031 Farwell, M. K.; Green, J. M.; Pepper, V. A. DISTRIBUTION AND KNOWN LIFE HISTORY OF /STICHAEUS PUNCTATUS/ IN THE NORTHWEST ATLANTIC. Copeia 1976 (3): 598-602. Aug. 1976. SFA 21(3).

[Fed. Dep. Environ., St. John's, NF, Canada]

76-001032 Germann, J. F.; McSwain, L. E.; Holder, D. R.; Swanson, C. D. LIFE HISTORY OF WARMOUTH IN THE SUWANNEE RIVER AND OKEFENOKEE SWAMP, GEORGIA. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 259-276. 1975. SFA 21(3).

[Ga. Dep. Nat. Resour., Game Fish Div., Waycross] Life history data were collected from Suwannee River and Okefenokee Swamp warmouth (/Lepomis gulosus/) from 19 July 1968 through 28 June 1973. Suwannee River warmouth became sexually mature in the third year of life, while warmouth from the Okefenokee Swamp became sexually mature in the second year of life. Collection of fecund warmouth suggested that the nesting season extended from April to late July or early August and that peak spawning generally occurred in early May. Fecundity estimates varied from 3,029 to 22,850 ova per female and generally increased with fish length. The average total lengths of Suwannee River warmouth at ages I through VIII were 52, 73, 105, 132, 158, 177, 189, and 214 mm, respectively. Okefenokee Swamp warmouth were 54, 90, 127, 154, 179, 179, and 190 mm at ages I through VII, respectively. The length-weight relationship of Suwannee River warmouth was $\log W = -5.4996 + 3.3726 \log L$. The equation, $\log W = -5.2395 + 3.2736 \log L$, described the length-weight relationship of Okefenokee Swamp warmouth. Warmouth of all lengths from both locations were carnivorous and fed on insects, fish, and crustaceans.

76-001033 Guseva, T. V. POSTEMBRYONIC DEVELOPMENT OF THE SEA PIKE-PERCH /LUCIOPERCA MARINA/ OF THE CASPIAN SEA. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (2): 245-256. 1975. SFA 21(3).

[Cent. Sci. Res. Inst. Sturgeon Farm., Krasnovodsk, USSR] The morpho-ecological features of the larval and fingerling periods of development of the sea pike-perch, /Lucioperca marina/, were studied. A qualitative description of the feeding of the larvae at all stages of development is given.

76-001034 Heidinger, R. C. LIFE HISTORY AND BIOLOGY OF THE LARGEMOUTH BASS. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington D.C. 11-20. 1975. SFA 21(3).

[Coop. Fish. Manage. Res. Lab., South. Ill. Univ., Carbondale 62901]

SPORT FISHERY ABSTRACTS

76-001035 Hurst, H.; Bass, G.; Hubbs, C. THE BIOLOGY OF THE GUADALUPE, SUWANNEE, AND REDEYE BASSES. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 47-53. 1975. SFA 21(3).

[Tenn. Wildl. Res. Agency, P.O. Box 40747, Nashville 37204]

76-001036 Miller, R. J. COMPARATIVE BEHAVIOR OF CENTRARCHID BASSES. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 85-94. 1975. SFA 21(3).

[Dep. Zool., Okla. State Univ., Stillwater 74074]

76-001037 Ots, J-P.; Eldon, G. A. DOWNSTREAM MOVEMENT OF FRY OF /GALAXIAS FASCIATUS/ GRAY. N. Z. J. Mar. Freshwater Res. 9 (1): 97-99. Mar. 1975. SFA 21(3).

[Fish. Res. Div., Minist. Agric. Fish., P.O. Box 19062, Wellington, New Zealand] The fry of /Galaxias fasciatus/ Gray were recorded for the first time, being carried downstream on a flood. Attempts to rear the fry in tanks in fresh and in salt water were unsuccessful, but those kept in salt water began to feed and survived for several weeks.

76-001038 Page, L. M. THE LIFE HISTORY OF THE STRIPETAILED DARTER, /ETHEOSTOMA KENNICOTTI/, IN BIG CREEK, ILLINOIS. Ill. Nat. Hist. Surv. Biol. Notes No. 93. 15p. Feb. 1975. SFA 21(3).

[Ill. Nat. Hist. Surv., Urbana 61801]

76-001039 Robertson, D. A. PLANKTONIC STAGES OF /MAUROLICUS MUELLERI/ (TELEOSTEI: STERNOPTYCHIDAE) IN NEW ZEALAND WATERS. N. Z. J. Mar. Freshwater Res. 10 (2): 311-328. June 1976. SFA 21(3).

[Fish. Res. Div., Minist. Agric. Fish., P.O. Box 19062, Wellington, New Zealand] The seasonality and distribution, abundance, and hydrological affinities of the planktonic stages of the sternoptychid /Maurolicus muelleri/ (Gmelin, 1788) are described for the New Zealand region. Spawning occurred from August to March, and the planktonic stages were widespread around New Zealand. Spawning probably takes place around midday at depths greater than 250 m. Eggs and larval stages were present over temperature ranges of 9.0-15.5°C and 13-22°C respectively.

76-001040 Sandow, J. T., Jr.; Holder, D. R.; McSwain, L. E. LIFE HISTORY OF THE REDBREAST SUNFISH IN THE SATILLA RIVER, GEORGIA. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 279-295. 1975. SFA 21(3).

[Ga. Dep. Nat. Resour., Game Fish Div., Waycross] Life history data were collected from redbreast sunfish, /Lepomis auritus/ (Linnaeus), in the Satilla River between 1 July 1970 and 30 June 1973. Spawning was observed in the Little Satilla River during May and June at water temperatures from 22.2°-24.4°C. Strong site preference was evident. Nests were associated with fallen trees, stumps, or logs. The average nest diameter was 93.5 cm and the preferred substrate was sand. Sex ratio was 1 male to 1.49 females. Fecundity estimates ranged from 322 to 9206 ova per female around a mean of 3302 ova. Fecundity increased with both length and weight. Average calculated total lengths of annulus I through VII were 59, 90, 125, 153, 181, 205, and 222 mm, respectively. The length-weight relationship of all redbreast examined was $\log W = -5.2810 + 3.2368 \log L$ ($r = .9759$). Redbreast from the upper river were heavier per given length than specimens from the lower river. The length-weight relationship of male redbreast sunfish differed significantly from that of females in both the upper and

76-001040 CCNTINUED

lower reaches of the river. Major food items were terrestrial and aquatic insects.

76-001041 Vogele, L. E. THE SPOTTED BASS. In H. Clepper, ed. Black Bass Biology and Management, Sport Fishing Inst., Washington, D.C. 34-45. 1975. SFA 21(3).

[U.S. FWS, Fayetteville, AR]

76-001042 Vooren, C. M. NURSERY GROUNDS OF TARAKIHI (TELEOSTEI: CHEILODACTYLIDAE) AROUND NEW ZEALAND. N. Z. J. Mar. Freshwater Res. 9 (2): 121-158. June 1975. SFA 21(3).

[Fish. Res. Div., Minist. Agric. Fish., Wellington, New Zealand]
The Tasman Bay nursery ground is 18-33 km wide and about 75 km long, with a surface area of about 2000 km². There is a rich demersal fish fauna (37 species were recorded) dominated by tarakihi, red gurnard /Chelidonichthys kumu/ (Lesson & Garnot), snapper /Chrysophrys auratus/ (Bloch & Schneider), and leatherjacket /Novodon convexirostris/ (Guenther). The young tarakihi occur at depths of 20-45 m and concentrate during winter in the warmer deeper water. They first appear in trawl catches in summer, towards the end of their first year (assumed birthdate is 1 March), and stay on the nursery until the age of 3 y. They occur in the deeper water off the nursery during their fourth and fifth year and depart during their sixth year, possibly for the spawning grounds off the west coast of the South Island. The mean lengths at the ages of 15, 27, and 39 months were 12.6, 18.0, and 24.0 cm respectively in 1970. There was some variation in growth rate within the nursery ground, but the age groups could nevertheless be recognised easily from length frequency modes. Monthly modal lengths showed that growth slows down in winter. Evidence for fluctuations in year class strength was found; year classes 1966 and 1969 were weak and year class 1968 was strong. --From abstr.

76-001043 Zilancv, V. K.; Shepel', L. I. NOTES ON THE ECOLOGY OF THE BLACK SCABBARDFISH, /APHANCPUS CARBO/, OF THE NORTH ATLANTIC. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (4): 661-663. 1975. SFA 21(3).

[North. Comm. Surv., Murmansk, USSR] The black scabbardfish is a deep-water species, distributed everywhere on the continental slope of the North Atlantic, and is encountered in greatest number at depths of 600-1200 m. According to peculiarities of behavior and distribution this fish is a demersopelagic species, making seasonal migrations on the slope and along the slope; foraging migrations are directed toward the northern parts of the range and lesser depths, prespawning ones--to southern sections. A determining factor of the seasonal dynamics of the black scabbardfish on the slope is the complex of abiotic conditions making possible the formation of local productive sections in zones of vertical circulation of the Atlantic waters.--From concl.

POPULATION STUDIES, PRODUCTION, ETC.

76-001044 Adams, S. M. THE ECOLOGY OF EELGRASS, /ZOSTERA MARINA/ (L.), FISH COMMUNITIES. II. FUNCTIONAL ANALYSIS. J. Exp. Mar. Biol. Ecol. 22 (3): 293-311. June 1976. SFA 21(3).

[Environ. Sci. Div., Oak Ridge Natl. Lab., Oak Ridge, TN]
Consumption, production, and respiration of fish communities utilizing two eelgrass beds in a shallow estuarine system near Beaufort, North Carolina have been estimated for 1971-1972: annual production was 21.7

76-001044 CONTINUED

kcal/m² in each bed with pinfish accounting for 45 and 68 percent of the production in the Phillips Island and Bogue Sound beds, respectively. Annual community respiration was 57.9 and 69.7 kcal/m² in the two beds with pinfish accounting for 62.6 and 26.7 percent of the total in the Bogue Sound and Phillips Island beds, respectively. Estimation of the annual food energy consumed by the eelgrass fish community using the Winberg and daily ration methods gave values within 6 percent of each other. Energy turnover was high (2.8), and the efficiency of energy dissipation low for the two eelgrass fish communities, suggesting that the resident fish populations were adapted to the temperature extremes within the bed. High ecological efficiencies of 0.24 and 0.23 and the high overall efficiency of the eelgrass system (production/solar radiation) of 0.0051 and 0.0086 percent indicate that the eelgrass beds are efficient systems for converting consumed energy and solar radiation into fish.

76-001045 Adams, S. M. THE ECOLOGY OF EELGRASS, /ZOSTERA MARINA/ (L.), FISH COMMUNITIES. I. STRUCTURAL ANALYSIS. J. Exp. Mar. Biol. Ecol. 22 (3): 269-291. June 1976. SFA 21(3).

[Environ. Sci. Div., Oak Ridge Natl. Lab., Oak Ridge, TN] Fish populations utilizing eelgrass, /Zostera marina/(L.), beds in two different estuarine areas near Beaufort, North Carolina were analysed and compared to determine aspects of their community structure. The fish community of the eelgrass beds was characterized by diversity and high standing crops of biomass and energy, both of which showed seasonal variation. Wide temperature fluctuations related to the overall shallowness of the beds probably regulated the diversity of fishes utilizing the beds. This community was dominated by pinfish, /Lagodon rhomboides/ (L.), which comprised 45 percent and 67 percent of the fish biomass in the Phillips Island and Bogue Sound beds, respectively. Changes in total body caloric content were probably related to development stages and changes in diet. Adult fish often had significantly higher weight-specific caloric contents than juvenile fish. Monthly or seasonal variations in caloric content of the organic matter of pinfish had little influence on the caloric content within the various sizes of pinfish. There was a significant correlation between fish biomass, temperature, and /Zostera/ biomass. Fish biomass was highest when temperature and grass biomass were at a maximum. In general, water depth over the beds had little effect on the standing crop of fish within the bed, but cooler waters which occurred at night, darkness, or both, had a large effect.

76-001046 Fajen, O. THE STANDING CROP OF SMALLMOUTH BASS AND ASSOCIATED SPECIES IN COURTOIS CREEK. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 240-249. 1975. SFA 21(3).

[Mo. Dep. Conserv., Columbia 65201]

76-001047 Houser, A.; Rainwater, W. C. PRODUCTION OF LARGEMOUTH BASS IN BEAVER AND BULL SHOALS LAKES. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 310-316. 1975. SFA 21(3).

[U.S. FWS, South. Cent. Reservoir Invest., Fayetteville, AR]

76-001048 Krogius, F. V. POPULATION DYNAMICS AND GROWTH OF YOUNG SOCKEYE SALMON, /ONCORHYNCHUS NERKA/, IN LAKE DAL'NEYE (KAMCHATKA). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (4): 549-564. 1975. SFA 21(3).

[KOTINRO, Petropavlovsk-Kamchatskiy, USSR] The distribution of body lengths in young sockeye salmon, /Oncorhynchus nerka/, from lake Dalneye, as well as the variability and skewness of this distribution, the relationship between growth of the young and size structure of the population, plus the importance of feeding conditions are examined. Possible reasons for the skewed distribution of body lengths are discussed, as well as the influence of ecological factors such as spawn quality, effect of predators and feeding conditions. The effect of skewness of the length distribution on the subsequent destiny of the young, their migration at various ages or transformation into residual, non-migratory fish is appraised. It is found that the relationship between the structure of population of young salmon and the conditions in the lake also characterizes the behavior of the entire lake ecosystem.

76-001049 Letichevskiy, M. A. EXPERIMENTAL DETERMINATION OF THE ABUNDANCE OF THE CASPIAN INCONNU, /STENODUS LEUCHICHTHYS/, AND THE EFFECTIVENESS OF HATCHERY PROPAGATION. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (4): 565-569. 1975. SFA 21(3).

[KaspNIRKh, USSR] A method is proposed for determination of the abundance of spawning populations of the Caspian inconnu, /Stenodus leuchichthys/, and survival of the young up to adult stages, which permits evaluation of reproductive success and to develop measures for increase of effectiveness of hatchery propagation.

76-001050 Winters, G. H. RECRUITMENT MECHANISMS OF SOUTHERN GULF OF ST. LAWRENCE ATLANTIC HERRING (/CLUPEA HARENGUS HARENGUS/). J. Fish. Res. Board Can. 33 (8): 1751-1763. Aug. 1976. In English with French summ. SFA 21(3).

[Dep. Environ., Fish. Mar. Serv., Biol. Stn., St. John's, NF A1C 1A1, Canada] Estimates of abundance of the southern Gulf of St. Lawrence herring complex by cohort analysis indicate that both biomass and population fecundity were reduced to low levels in the late 1950s following a widespread fungus disease in the mid-1950s. As a result of two strong year-classes in the late 1950s, however, abundance increased dramatically up to 1964 but has declined continuously since then due mainly to subsequent poor recruitment. Mackerel were also at low levels of abundance in the late 1950s and remained so until the mid-1960s when a series of strong year-classes produced a rapid increase in abundance to the extent that mackerel replaced herring as the dominant pelagic fish in the southern Gulf ecosystem. Changes in herring recruitment, growth, and maturation rates are investigated in relation to changes in herring biomass and total pelagic (herring + mackerel) biomass. Density-dependent changes in all three parameters have occurred in herring; mackerel also have interacted with the growth and recruitment of southern Gulf herring. This suggests that the carrying capacity of the southern Gulf for pelagic fish is limited and that competition and predation by mackerel intensifies the logistic response of herring. Thus, recruitment of southern Gulf herring in the period under consideration was largely controlled by the total pelagic biomass, acting mainly through herring up to the mid-1960s and through mackerel since then. The increase in mackerel abundance is attributed to a combination of favorable temperature regime and optimum spawning biomass. That being so, the probability of large year-classes of herring in the near future will depend heavily on the interaction between favorable survival conditions for mackerel and the effectiveness of ICNAF regulations to maintain mackerel

76-001050 CONTINUED
biomass at maximum recruitment levels.

SPAWNING HABITS AND MOVEMENTS, FECUNDITY, ETC.

76-001051 Allan, R. C.; Romero, J. UNDERWATER OBSERVATIONS OF LARGEMOUTH BASS SPAWNING AND SURVIVAL IN LAKE MEAD. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 104-112. 1975. SFA 21(3).
[Nev. Dep. Fish Game, Box 10678, Reno 89510]

76-001052 Avila, V. L. A FIELD STUDY OF NESTING BEHAVIOR OF MALE BLUEGILL SUNFISH (*LEPOMIS MACROCHIRUS*/ *RAFINESQUE*). Am. Midl. Nat. 96 (1): 195-206. July 1976. SFA 21(3).
[Dep. Zool., San Diego State Univ., San Diego, CA 92182] The nesting behavior of male bluegill sunfish (*Lepomis macrochirus*) in the field was described with particular emphasis on the frequency of selected agonistic and reproductive behaviors as a function of nest-site location. Nest construction, courtship and spawning were typical of the family Centrarchidae. Agonistic behavior was increased in crowded nesting situations. Spawning males were more aggressive than nonspawning males and often left the nest, which provided opportunities for other males to enter the nest and engage the female. Simultaneous polygamous spawning is a natural, although relatively rare, occurrence for bluegills.

76-001053 Danilov, N. N. CONDITIONS OF REPRODUCTION AND PREREQUISITES FOR BIOLOGICAL DIFFERENTIATION IN THE KUYBYSHEV RESERVOIR POPULATION OF BREAM *ABRAMIS BRAMA*. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (2): 196-202. 1975. SFA 21(3).
[Kazan' Univ., USSR] The reproductive process of the bream *Abramis brama* at the upper end of the impounded water zone of Kuybyshev reservoir during different temperature and water level regimes in the year was investigated. Data on the nature of the spawning, substrate, survival of eggs and larvae and their distribution in relation to environmental conditions are given. The difference between bream spawners spawning at a different temperature and on a different substrate is established.

76-001054 Gale, W. F.; Gale, C. A. SELECTION OF ARTIFICIAL SPAWNING SITES BY THE SPOTFIN SHINER (*NOTROPIS SPILOPTEUS*). J. Fish. Res. Board Can. 33 (9): 1906-1913. Sept. 1976. In English with French Summ. SFA 21(3).

[Ichthyological Assoc., Inc., Berwick, PA 18603] Visual cues and water currents were important in spawning-site selection. Spotfins deposited 43,638 eggs on black discs and only 2 eggs on clear discs; 87 percent of the eggs were in horizontal crevices and the remainder in vertical crevices paralleling (7 percent) and perpendicular (6 percent) to the current. Fish spawned over the entire disc in slow currents but avoided strong currents (0.57 m/s) by spawning on the downstream side of the discs. Nearly 90 percent of the eggs were deposited in crevices 1.5 and 3.0 mm wide, the two smallest sizes. In angular crevices 15-90° from horizontal, fish deposited 74 percent of 8,358 eggs in the 15° crevice and 24 percent in the 30° crevice. A stack of black acrylic plates was placed near the river surface, at midwater, and near the bottom. In July fish deposited 91 percent of 13,088 eggs in the bottom stack. By mid-August stack usage had changed and 80 percent of 11,456 eggs were in the surface stack; the others

76-001054 CONTINUED

were in the midwater stack. In another experiment, 95 percent of 46, 328 eggs were placed in crevices between blue (55 percent) and black (40 percent) plates; other colors were green (4 percent), red (1 percent), and white, yellow, and orange (less than 1 percent). Fish usually spawned on the plates between 0600 and 1000; spawning did not occur at night. The spotfin has potential as a bioassay organism because of its wide distribution, the ease with which large numbers of its eggs can be collected, its extended breeding season, and the simplicity of rearing the young.

76-001055 Galkin, A. S.; Kovalev, S. M. FECUNDITY OF THE CAPELIN, /MALLOTUS VILLOSUM VILLOSUM/, OF THE BARENTS SEA. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (4): 579-583. 1975. SFA 21(3).

[PINRO, Murmansk, USSR] Change in the fecundity of the capelin, /Mallotus villosus villosus/, of the Barents Sea was examined. It was shown that since 1968 the mean individual fecundity of the capelin has decreased gradually from 21,500 eggs (1968) to 11,300 eggs (1971). The change in individual fecundity of the capelin is closely connected with the abundance of this fish. The appearance of a number of productive generations of the capelin in the Barents Sea led to increase in the abundance of the spawning stock, which in turn caused decrease in its individual fecundity. Fluctuation of the fecundity of the capelin by years can be regarded as one of the features of self-regulation of the abundance of the stock.

76-001056 Hourston, A. S.; Bcsenthal, H. SPERM DENSITY DURING ACTIVE SPAWNING OF PACIFIC HERRING (/CLUPEA HARENGUS PALLASI/). J. Fish. Res. Board Can. 33 (8): 1788-1790. Aug. 1976. In English with French summ. SFA 21(3).

[Dep. Environ., Fish. Mar. Serv., Pac. Biol. Stn., Nanaimo, BC V9R 5K6, Canada] Discharge of milt by spawning Pacific herring (/Clupea harengus pallasii/) produces a milky discoloration in the water which is readily observed under favorable conditions of weather and light. Echo-sounder tracings showed that only the inshore part of a spawning school that was in contact with the bottom participated in the early stages of spawning. Sperm densities at the surface for two spawnings averaged 148 and 129 sperm/ml (range 80-210 for 16 subsamples). This density is considered more than ample for high fertilization success but is only one-tenth that normally used for artificial fertilization in the laboratory at Nanaimo.

76-001057 Kutuzov, A. M. THE EFFECTIVENESS OF REPRODUCTION OF THE WHITE BREEM, /ELICCA BJOERKNA/, AND THE ROACH, /RUTILUS RUTILUS/, IN THE UPPER SECTION OF KUYBYSHEVSKOE RESERVOIR. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (4): 678-682. 1975. SFA 21(3).

[Dep. Vert. Zool., Kazan State Univ., USSR] The most favorable hydrometeorological conditions for reproduction of the white bream occurred in 1960, 1961, 1964, 1965 and 1968, when its massive spawning coincided with repeated rise of the water level. In the white bream of the upper part of Kuybyshevskoe Reservoir, although there is dependence of the abundance of separate generations on the conditions of reproduction in the respective year, this dependence is not manifested so sharply as in other commercial phytophilic fishes. Owing to the lengthiness of spawning the abundance of the white bream depends to a lesser degree on fluctuations of the level. Usually, in years unfavorable for spawning, the effectiveness of reproduction of the roach is high, which guarantees certain stability in maintenance of the stocks of species of small fishes.--From concl.

76-001058 Lyagina, T. N. CONNECTION OF EGG WEIGHT WITH BIOLOGICAL INDICES OF FEMALE ROACH, /RUTILUS RUTILUS/, WITH DIFFERENT ABUNDANCE OF FOOD. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiolog.) 15 (4): 584-594. 1975. SFA 21(3).

[Dep. Ichthyol., Moscow State Univ., Moscow, USSR] The influence of food availability in the year that preceded spawning, on the weight of the egg of roach of one age, as well as the strength of the connection between the weight of the eggs and indices of the females was examined. In roach females of one age the spawn reaches the greatest weight under the worst feeding conditions and low fecundity. Improvement of the food supply entails increase in fecundity and decrease in the weight of the egg. With abundant food the coefficients of correlation of the weight of the spawn with the examined indices of the females are close to one another; the difference between these values grows according to the degree of deterioration of the conditions.

76-001059 Makarova, N. P. DIFFERENCES IN THE BIOLOGICAL INDICATORS OF SEXUALLY MATURE AND IMMATURE FEMALE PERCH, /PERCA FLUVIATILIS/, FROM UGLICH RESERVOIR. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiolog.) 15 (2): 330-334. 1975. SFA 21(3).

[IEMEZh, Moscow, USSR]

76-001060 Messieh, S. N. FECUNDITY STUDIES ON ATLANTIC HERRING FROM THE SOUTHERN GULF OF ST. LAWRENCE AND ALONG THE NOVA SCOTIA COAST. Trans. Am. Fish. Soc. 105 (3): 384-394. May 1976. SFA 21(3).

[Dep. Environ., Fish. Mar. Serv., Biol. Stn., St. Andrews, NB E0G 2X0, Canada] Fecundity estimates were made on 428 mature herring (/Clupea harengus harengus/ L.) (maturation stages 4 and 5) collected from the southern Gulf of St. Lawrence and the Nova Scotia coast. Estimates ranged from 23,000 to 261,000 eggs per female. Fecundity increased exponentially with the fish length and weight at different rates for different herring stocks. Values of the exponent ranged between 3.7-5.3 and 1.1-1.6 for length and weight, respectively. Results of regression analyses showed that fecundity depended more on fish weight and length than on age. Fecundity of spring-spawning herring was significantly lower than that of autumn spawners, but the differences between areas were not significant. The lower fecundity of spring spawners was associated with an increase in their egg weight. An index relating fecundity to the cube of fish length was used in an attempt to identify different stocks. The separation between spring- and autumn-spawning groups was distinct, but the different stocks within a spawning group could not be separated.

76-001061 Panasenkov, V. A. SOME FEATURES OF THE REPRODUCTION AND PRESENT STATE OF THE SPAWNING POPULATION OF THE BREEM /ABRAMIS BRAMA/ IN KURSHA BAY. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiolog.) 15 (2): 232-239. 1975. SFA 21(3).

[AtlantNIRO, Kaliningrad, USSR] Data are given on the reproductive features of the bream /Abramis brama/ in relation to changes in environmental factors and the quality of the spawners. The present state of the spawning part of the population is evaluated, and changes which have occurred as a result of an increase in the overall abundance of bream in Kursha Bay are recorded.

76-001062 Perry, W. G. BLACK AND BIGMOUTH BUFFALO SPAWN IN BRACKISH WATER PONDS. Prog. Fish-Cult. 38 (2): 81. Apr. 1976. SFA 21(3).

[La. Wildl. Fish. Comm., Grand Chenier 70643] Black buffalo (*Ictiobus niger*) and bigmouth buffalo (*I. cyprinellus*) spawned in brackish water ponds in coastal southwest Louisiana. The salinities ranged from 1.6 to 1.8 percent in the black buffalo pond and 1.4 to 2.0 percent in the bigmouth buffalo pond.

76-001063 Sedletskaya, V. A. THE DYNAMICS OF MATURATION OF THE HORSEMACKEREL /TRACHURUS TRACHURUS/ FROM DIFFERENT REGIONS OF THE CENTRAL-EASTERN ATLANTIC AND THE DISTRIBUTION OF SPAWNING GROUNDS DEPENDING ON THE SEASONAL POSITION OF THE HYDROLOGIC FRONTAL ZONE. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (2): 239-245. 1975. SFA 21(3).

[AtlantNIRO, Kaliningrad, USSR] A change in the maturation of gonads of the horse mackerel, *Trachurus trachurus*, from four regions of the central-eastern Atlantic in the course of a year is considered. The hydrologic frontal zone determines, to a considerable extent, the distribution of horse mackerel spawning grounds. No drift of eggs or larvae was observed.

76-001064 Stanley, J. G. REPRODUCTION OF THE GRASS CARP (*CTENOPHARYNGODON IDELLA*) OUTSIDE ITS NATIVE RANGE. Fisheries (Bull. Am. Fish. Soc.) 1 (3): 7-10. May-June 1976. SFA 21(3).

[Me. Coop. Fish. Res. Unit, Univ. Me., Orono 04473] Grass carp (*Ctenopharyngodon idella*) spawned after they were introduced into the Volga, Ili, Terek, Amu-Darya, and Kuban Rivers, and the Kara-Kum Canal of the Soviet Union; the Tone River of Japan; the Ah Kung Tien Reservoir of Taiwan; the Pampangi River of the Philippines; and the Rio Balsas and the Bodegas Lake system of Mexico. Natural reproduction in the United States seems likely as soon as the large numbers of grass carp released in the Mississippi River system in 1973-1975 reach sexual maturity, probably in 1978 or 1979.

76-001065 Thomson, D. A.; Lehner, C. E. RESILIENCE OF A ROCKY INTERTIDAL FISH COMMUNITY IN A PHYSICALLY UNSTABLE ENVIRONMENT. J. Exp. Mar. Biol. Ecol. 22 (1): 1-29. Apr. 1976. SFA 21(3).

[Dep. Ecol. Evol. Biol., Univ. Ariz., Tucson] A 7-year census of intertidal fishes has been made by repeated defaunation of tide pools in the northern Gulf of California. The intertidal fish community showed long-term resilience, and hence stability, under a rigorous, unstable physical environment. Although the majority of fishes have tropical affinities (76 percent), warm temperature species (24 percent) constitute 33 percent of total numbers and 69 percent of total biomass of the entire intertidal fish community. Short-term seasonal fluctuations in species diversity and population numbers of temperate fishes were in better synchrony with the annual light regime and sea temperature cycles than those of tropical species. A winterkill due to abnormally low sea temperatures in January, 1971, exerted faunal selection by killing several tropical fishes. Warm temperate species tolerated these low temperatures both experimentally and during the 1971 winterkill. Low sea temperatures were judged to be more limiting to diversity than high sea temperatures. The seasonal tidal pattern in the northern Gulf of California moderates summer heating but accentuates winter cooling thus favoring winterkills. We conclude that this intertidal fish community, dominated by *r/r*-selected species, is more physically controlled than biologically accommodated, and the temperate species play an important role in regulating the stability of this fish assemblage.

76-001066 Webster, D. A.; Eiriksdoottir, G. UPWELLING WATER AS A FACTOR INFLUENCING CHOICE OF SPAWNING SITES BY BROOK TROUT (*Salvelinus fontinalis*). Trans. Am. Fish. Soc. 105 (3): 416-421. May 1976. SFA 21(3).

[Dep. Nat. Resour., Cornell Univ., Ithaca, NY 14850] Brook trout (*Salvelinus fontinalis*) generally select areas of upwelling spring water for spawning under natural conditions. When presented with suitable gravel containing an artificially controlled aquifer of about 0.1 percent the area of a circular tank, female trout selected spawning sites that were either in close proximity to the upwelling water or adjacent to it in 21 of 22 trials. Average time lapse for completion of spawning was about 30 hours. Use of a tank several times larger than 1.9 m² would probably improve conditions for making more precise observations on discrimination of aquifers under laboratory conditions.

MOVEMENTS, SEASONAL AND DEPTH DISTRIBUTION, ETC.

76-001067 Clarke, T. A.; Wagner, P. J. VERTICAL DISTRIBUTION AND OTHER ASPECTS OF THE ECOLOGY OF CERTAIN MESOPELAGIC FISHES TAKEN NEAR HAWAII. NCAA Fish. Bull. 74 (3): 635-645. July 1976. SFA 21(3).

[Hawaii Inst. Mar. Biol., P.O. Box 1346, Kaneohe 96744] Data on abundance, size, depth and time of capture, and sexual development are presented for 37 species of 15 families of rare to moderately abundant mesopelagic fishes taken in the central Pacific. These exhibit a wide variety of patterns of vertical distribution and diel migration. Several undertake migrations similar in extent to those of most myctophids and migrating stomiatoids, while others remain at depth both day and night. In between are species where occurrence or extent of migration are related to size. A trend for juveniles to occur shallower than adults, already noted in myctophids and stomiatoids, is present in most species covered here regardless of migration pattern. Sexual differences in adult size and uneven sex ratios are indicated for several species. The interplay between sexual dimorphism, size difference, and sex ratio and the consequences to reproductive strategy are briefly discussed.

76-001068 Gabriel, W. L.; Leggett, W. C.; Carscadden, J. E.; Glebe, B. D. ORIGIN AND CHARACTERISTICS OF "FALL-RUN" AMERICAN SHAD (*Alosa sapidissima*) FROM THE ST. JOHN RIVER, NEW BRUNSWICK. J. Fish. Res. Board Can. 33 (8): 1764-1770. Aug. 1976. In English with French Summ. SFA 21(3).

[W. C. Leggett: Dep. Biol., McGill Univ., Montreal, PQ H3C 3G1, Canada] American shad (*Alosa sapidissima*) taken from the St. John River, New Brunswick, during the fall of 1973 were studied to determine river of origin and duration of residence in the river. One-way analyses of variance and classification by discriminant function analysis of meristic characters suggested that most of these shad were part of the St. John River population. Fat and water content of the fish, maturity, and stomach contents suggested that the movement into the estuary was recent and not a spawning migration.

76-001069 Gebhart, G. E.; Summerfelt, R. C. FACTORS AFFECTING THE VERTICAL DISTRIBUTION OF WHITE CRAPPIE (*POMOXIS ANNULARIS*) IN TWO OKLAHOMA RESERVOIRS. Proc. Annu. Conf. Southeast. Assoc. Game fish Comm. 28: 355-366. 1975. SFA 21(3).

[Okla. Coop. Fish. Res. Unit, Okla. State Univ., Stillwater 74074] Mean depth of capture of the white crappie in horizontal, bottom set gill nets in Arbuckle Reservoir in 1973 was not statistically different from that in this reservoir in 1974, or from that in Eufaula Reservoir (determined by collection in vertical gill nets) in 1968. The white crappie depth distribution was generally similar in these two reservoirs, and there was a seasonal cycle of distribution related primarily to changes in temperature and dissolved oxygen. Lake Arbuckle was acutely stratified by midsummer of both years. Stratification in this reservoir appeared to force white crappie into the thermocline but anoxic conditions excluded them from the hypolimnion. In Eufaula Reservoir, white crappie were distributed deeper when surface temperatures increased but their depth distribution was not limited by anoxic water. White crappie were found nearer the surface in the fall when surface water cooled.

76-001070 Kelso, J. R. M. DIEL MOVEMENT OF WALLEY, *STIZOSTEDION VITREUM VITREUM*, IN WEST BLUE LAKE, MANITOBA, AS DETERMINED BY ULTRASONIC TRACKING. J. Fish. Res. Board Can. 33 (9): 2070-2072. Sept. 1976. In English with French summ. 21(3).

[Dep. Environ., Fish. Mar. Serv., Great Lakes Biolimnol. Lab., Sault Ste. Marie, ON P6A2B3, Canada] Eight walleye (*Stizostedion vitreum vitreum*) between 2 and 5 yr of age were equipped with ultrasonic transmitters, released, and followed for periods up to 24 h. During the study period, September 24-October 2, 1975, West Blue Lake was thermally stratified. Movement was limited to the homothermous epilimnion, above 10 m, and to the region of steeply sloping bottom of about 5-10 m which was usually within 100 m of shore. Midbasin crossings of the lake were infrequent. Transmitter attachment caused temporary high activity after which a more normal rhythm was apparent with peaks of activity at dusk and dawn. The majority, 86 percent, of observed swimming speeds were under 1 body length s^{-1} . Since much localized activity, too restricted to measure, was apparent, these observations must be regarded as only approximations of natural activity.

76-001071 Lindenberg, J. G. SEASONAL DEPTH DISTRIBUTION OF LANDLOCKED ALEWIVES, *ALOSA PSEUDOHARENGUS* (WILSON), IN A SHALLOW, EUTROPHIC LAKE. Trans. Am. Fish. Soc. 105 (3): 395-399. May 1976. SFA 21(3).

[Mass. Div. Fish. Wildl., Westboro 01581] Seasonal depth distribution of landlocked alewives, *Alosa pseudoharengus* (Wilson), was determined in a shallow eutrophic lake. In spring they were concentrated in the deepest and coldest water, or less commonly near the warmer surface waters. During summer, alewives were evenly distributed above the anoxic hypolimnion. Their fall and winter actions were pelagic being characterized by avoidance of both surface and bottom waters.



76-001072 Sabins, D. S.; Truesdale, F. M. DIEL AND SEASONAL OCCURRENCE OF IMMATURE FISHES IN A LOUISIANA TIDAL PASS. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 161-171. 1975. SFA 21(3).

[Sch. Forest. Wildl. Manage., La. State Univ., Baton Rouge 70803] A 15-month study of a natural tidal pass on the southeastern Louisiana coast revealed that the pass and adjacent inshore waters are utilized by a variety of immature fishes as immigration pathway and/or nursery. Eighty species representing 39 families were found to occur in the pass area, including young of several commercial and sport fishes. Two seasonal assemblages of immature fishes were identified, cold- and warmwater. Coldwater species were mostly immigrating young of offshore spawners, while warmwater species were mostly young of inshore spawners. The catch of coldwater species was influenced more by tidal stages than light periods; warmwater species exhibited varied diel catch patterns but the catch of predominant warmwater species was more closely associated with light periods than tidal stages. The similarity in diel patterns exhibited by some of the coldwater assemblage indicates that this group may react similarly to the problem of inshore transport (immigration).

FOODS AND FEEDING

76-001073 Arthur, D. K. FOOD AND FEEDING OF LARVAE OF THREE FISHES OCCURRING IN THE CALIFORNIA CURRENT, /SARDINOPS SAGAX/, /ENGRAULIS MORDAX/, AND /TRACHURUS SYMMETRICUS/. NOAA Fish. Bull. 74 (3): 517-530. July 1976. SFA 21(3).

[NMFS, Southwest Fish. Cent., P.O. Box 271, La Jolla, CA 92038] The size, number, and types of food particles eaten by larvae of Pacific sardine, /Sardinops sagax/; northern anchovy, /Engraulis mordax/; and jack mackerel, /Trachurus symmetricus/, were determined by an examination of gut contents of larvae captured in plankton samples from the California Current. Food particles found in larvae of the three fishes were predominantly the eggs, nauplii, and the copepodid stages of the smaller species of copepods. These increased in width as the larvae grew though not so uniformly for the anchovy as for sardine and jack mackerel. Particles ingested by anchovies at first feeding were slightly larger than were those ingested by sardines, while jack mackerel could eat particles three times wider than sardines of equal length. The smallest individuals of each species were the most euryphagous, especially anchovies. Feeding incidence of sardine and anchovy declined during the early larval period while that of jack mackerel increased. Sardine and anchovy larvae fed only during the day. The data were not analyzed for day-night feeding for jack mackerel. The relative body depth and relative weight of laboratory-grown anchovy larvae increased throughout the larval periods examined, whereas, the relative body depth of most ocean-caught anchovy larvae decreased during the first half of this period, possibly as a result of the poorer ration obtainable in the ocean. The decline in relative body depth of ocean-caught anchovy larvae may be related to the decline in feeding incidence and to the apparent lack of increase in size of the food particles ingested.

76-001074 Cadwallader, P. L. FEEDING HABITS OF TWO FISH SPECIES IN RELATION TO INVERTEBRATE DRIFT IN A NEW ZEALAND RIVER. N. Z. J. Mar. Freshwater Res. 9 (1): 11-26. Mar. 1975. SFA 21(3).

[Fish. Wildl. Div., Minist. Conserv., 632 Bourke St., Melbourne, Victoria, Australia 3000] The relationship between the composition of the invertebrate drift fauna and the feeding habits of the common river galaxias *Galaxias vulgaris* and the upland bully *Philypnodon breviceps* was examined in the Glentui River, Canterbury, New Zealand, between 1500 h on 12 November and 1500 h on 13 November 1971. The drift consisted of both night-active and day-active components. *Galaxias vulgaris* fed mainly at night, with peaks of feeding at dusk and dawn. *Philypnodon breviceps* had two peaks of feeding, at midday and midnight, between the peak feeding times of *G. vulgaris*. Feeding of *G. vulgaris* on its major food items coincided with the presence of the food items in the drift, whereas feeding of *P. breviceps* did not coincide with the occurrence of the food items in the drift. It is concluded that *G. vulgaris* is primarily an openwater feeder and that *P. breviceps* searches for food on the river bed.

76-001075 Cadwallader, P. L. OCCURRENCE OF GRAVEL IN THE STOMACHS OF TWO NEW ZEALAND STREAM-DWELLING FISH. N. Z. J. Mar. Freshwater Res. 9 (1): 101-103. Mar. 1975. SFA 21(3).

[Fish. Wildl. Div., Minist. Conserv., 632 Bourke St., Melbourne, Victoria, Australia 3000] Gravel occurred in the stomachs of 17.8 percent of 924 *Galaxias vulgaris* and 2.8 percent of 430 *Philypnodon breviceps* taken from the Glentui River, Canterbury, between June 1970 and November 1971. It is suggested that differences in feeding habits and feeding locality are responsible for the difference in occurrence of gravel in the stomachs of the two fish species. *Galaxias vulgaris* feeds in the water column in riffles and, being a drift feeder, is more likely to ingest inedible material by accident than is *P. breviceps*, which feeds on the bottom in sheltered or quiet stretches of the river.

76-001076 Cadwallader, P. L. SPONTANEOUS LOCOMOTORY ACTIVITY OF *GALAXIAS VULGARIS*/ STOKELL (FISCES: SALMONIFORMES). N. Z. J. Mar. Freshwater Res. 9 (1): 27-34. Mar. 1975. SFA 21(3).

[Fish. Wildl. Div., Minist. Conserv., 632 Bourke St., Melbourne, Victoria, Australia 3000] Feeding of captive *Galaxias vulgaris* was found to be dependent on open-water activity. It did not occur when fish remained beneath boulders. Patterns of spontaneous locomotory activity of individual fish were recorded to determine potential feeding times. The apparatus used to measure spontaneous locomotory activity is described. Fish were found to be active mainly at night for most of the year, but became predominantly diurnal during the spawning period.

76-001077 Colin, P. L. FILTER FEEDING AND PREDATION ON THE EGGS OF *THALLASOMA* SP. BY THE SCOMBRID FISH *RASTRELLIGER KANAGURTA*. Copeia 1976 (3): 596-597. Aug. 1976. SFA 21(3).

[Dep. Mar. Sci., Univ. Puerto Rico, Mayaguez, PR 00708]

76-001078 Duka, L. A. FEEDING AND FOOD REQUIREMENTS OF YOUNG FISHES OF THE FAMILY LABRIDAE IN THE BLACK SEA. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiolog.) 15 (2): 219-226. 1975. SFA 21(3).

[Inst. Biol. South. Seas, Sevastopol, USSR] Data are given on the 24-hourly ration of wrasse fingerlings (family Labridae) obtained from the wet and dry weights of prey and consumers and from their calorific value. Data on the food requirements of fingerlings have been obtained.

76-001079 Edgar, R. K.; Hoff, J. G. GRAZING OF FRESHWATER AND ESTUARINE, BENTHIC DIATOMS BY ADULT ATLANTIC MENHADEN, *BREVOORTIA TYRANNUS*. NOAA Fish. Bull. 74 (3): 689-693. July 1976. SFA 21(3).

[Hellerman Diatom Herbarium, Southeast. Mass. Univ., North Dartmouth, MA 02747]

76-001080 Gorelova, T. A. THE FEEDING OF FISHES OF THE FAMILY MYCTOPHIDAE. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiolog.) 15 (2): 208-219. 1975. SFA 21(3).

[USSR Acad. Sci., Moscow, USSR] The stomachs of 988 myctophids between 11 and 70 mm long and belonging to the group of "near-surface" myctophids were investigated. The basis of the rations of these fish was constituted by Copepoda, Amphipoda, Euphausiacea, Mysidacea, Chaetognatha and Appendicularia. Two feeding rhythms were established: in fingerlings up to 25 mm long two peaks, in juveniles more than 25 mm long one peak.

76-001081 Hobson, E. S.; Chess, J. R. TROPHIC INTERACTIONS AMONG FISHES AND ZOOPLANKTERS NEAR SHORE AT SANTA CATALINA ISLAND, CALIFORNIA. NCAA Fish. Bull. 74 (3): 567-598. July 1976. SFA 21(3).

[NMFS, Southwest Fish. Cent., Tiburon, CA 94920] Predation pressures from fishes have influenced major evolutionary trends among shallow-water zooplankters, as concluded from study at Santa Catalina Island, Calif. The predominant zooplanktivorous fishes near shore are actinopterygians, an evolutionary line that has centered around generalized visually feeding, large-mouthed predators. Historically, zooplankters threatened by these fishes have faced selective pressures favoring reduced size, transparency, and/or nocturnal planktonic habits. At present, most zooplankters in the nearshore water column by day are very small. Their small size precludes capture by most large-mouthed fishes, thus providing protection in daylight. Larger zooplankters in the water column by day tend to be transparent. Zooplankters having sizes and other features making them vulnerable to large-mouthed fishes tend to enter the water column only at night. Because successful defensive features of prey create pressures that modify the offensive features of predators, the tendencies toward reduced size and nocturnal habits among zooplankters have generated appropriate adaptations among planktivorous fishes. Fishes that prey as adults on zooplankters during the day have specialized features that permit even relatively large individuals to take the tiny organisms. Some other fishes are diurnal planktivores only as small juveniles and assume different feeding habits as they grow larger. Fishes that prey on zooplankters at night take the larger organisms that join the zooplankton after dark. --From abstr.

76-001082 Janssen, J. FEEDING MODES AND PREY SIZE SELECTION IN THE ALEWIFE (*ALOSA PSEUDOHARENGUS*). J. Fish. Res. Board Can. 33 (9): 1972-1975. Sept. 1976. In English with French summ. SFA 21(3).

[Dep. Zool., Univ. Wis., Milwaukee 53201] Alewives (*Alosa pseudoharengus*) feed on zooplankton in three modes: 1) particulate feeding on individual prey; 2) filtering with the mouth held agape, accompanied by strong swimming; and 3) gulping, in which the mouth opens and closes more slowly than a particulate feeder and more rapidly than a filterer, and swimming is slower than in a filterer. Individuals that feed by filtering are not size selective; gulpers are size selective; and particulate feeders are more size selective than gulpers. Gulpers and filterers take more than 1 prey per mouth opening and closing; particulate feeders take only 1.

76-001083 Kogan, A. V. SEASONAL AND SIZE-AGE DIFFERENCES IN THE DIET OF THE TYULKA, *CLUPECNELLA DELICULATA*, OF KUYBYSHEVSKOE RESERVOIR. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (4): 683-687. 1975. SFA 21(3).

[Inst. Biol. Inland Waters, Kuybyshev, USSR]

76-001084 Manzer, J. I. DISTRIBUTION, FOOD, AND FEEDING OF THE THREESPINE STICKLEBACK, *GASTEROSTEUS ACULEATUS*, IN GREAT CENTRAL LAKE, VANCOUVER ISLAND, WITH COMMENTS ON COMPETITION FOR FOOD WITH JUVENILE SOCKEYE SALMON, *ONCORHYNCHUS NERKA*. NOAA Fish. Bull. 74 (3): 647-668. July 1976. SFA 21(3).

[Dep. Environ., Pac. Biol. Stn., Nanaimo, BC V9R 5K6, Canada] Stickleback appeared along shore in relatively low numbers prior to mid-April and most were between 30 and 59 mm long. Following spawning in June and July, initially stickleback were smaller, but as fish of the year became more available, both the number and average size of stickleback increased. They were absent in the littoral zone by November, but their presence in the pelagic zone in winter could not be established. Over the diel cycle the larger individuals apparently move offshore during the day. The populations in the 2 yr did not differ greatly in size. They predominantly fed on two cladocerans, two copepods, and a cyclopoid copepod. Larvae and pupae of the family Chironomidae were also of some importance. Other food items, but of minor importance, included harpacticoid copepods, insects, pelecypods, ostracods, acarids, Araneida, planaria, Odonata, and fish. Variations in diet in relation to season, size and sexual maturity of stickleback, and time of day were observed. The daily ration for stickleback was estimated to be 6.55 percent of their body weight in July and 7.80 percent in October. Stickleback and juvenile sockeye salmon in the littoral zone exhibited considerable dietary overlap, especially during the late spring and summer. However, since sockeye salmon in this zone are relatively few in number, and stickleback do not inhabit the limnetic zone, serious interspecific competition for food in the lake is probably lacking, especially in years of abundant food supply. --From abstr.

76-001085 Minckley, C. O.; Paulson, L. J. USE OF GIZZARD WEIGHTS TO DETERMINE TOTAL LENGTH AND WEIGHT OF THREADFIN SHAD EATEN BY PREDATORS. Trans. Am. Fish. Soc. 105 (3): 409-410. May 1976. SFA 21(3).

[Dep. Biol., Univ. North. Ariz., Box 5640, Flagstaff 86001] Threadfin shad gizzard weights were used to determine the total length and total weight of threadfin shad. It was found that a high degree of correlation existed among the parameters tested and that the best relationship was between body weight to gizzard weight empty. Using this information it is possible to estimate the weights of threadfin

76-001085 CCNTINUED
shad eaten by predatory fish.

76-001086 Moriarty, D. J. W. QUANTITATIVE STUDIES ON BACTERIA AND ALGAE IN THE FOOD OF THE MULLET /MUGIL CEPHALUS/ L. AND THE PRAWN /METAPENAEUS BENNETTAE/ (RACEK & DALL). J. Exp. Mar. Biol. Ecol. 22 (2): 131-143. May 1976. SFA 21(3).

[Div. Fish. Oceanogr., C.S.I.R.O., P.O. Box 120, Cleveland, Qld., Australia] The biomass of bacteria ingested by two deposit-feeding animals has been estimated by measuring the muramic acid in their gut contents. Bacteria comprised about 15 to 30 percent of the organic carbon in the stomach of the mullet /Mugil cephalus/ L. feeding on sea-grass flats, and about 20 to 35 percent of organic carbon in the proventriculus of the prawn /Metapenaeus bennettiae/ (Racek & Dall) feeding on muddy estuarine sediments. Diatoms made up about 20 to 30 percent of the carbon in the mullet stomachs, but algae were unimportant in the food of most of the prawns examined. In the mullet stomachs, total organic carbon was about 2 to 3 percent of ash weight, an increase of 10 to 20 fold over that in the /in situ/ sediments. The prawns were much more selective in their feeding since the organic carbon was about 30 to 45 percent of ash weight in the proventriculus. Evidence is presented which suggests that the mullet feed only during the day and not at night on the sea-grass flats. A regression equation is given for the dry weight of sediment in the full gut on fresh weight of fish. A calculation of the amount of sediment (and hence bacteria and algae) eaten per day by a given fish, exemplifies the application of the available tentative data.--From abstr.

76-001087 Paragamian, V. L. VULNERABILITY OF THREE SPECIES OF FORAGE FISH TO PREDATION BY SMALLMOUTH BASS IN A HATCHERY TROUGH. Prog. Fish-Cult. 38 (2): 86-87. Apr. 1976. SFA 21(3).

[Chariton Res. Stn., Red Haw State Park, Chariton, IA 50049] Vulnerability of common shiner (/Notropis cornutus/), hornyhead chub (/Nocomus biguttatus/), and white sucker (/Catostomus commersoni/) to predation by smallmouth bass (/Micropterus dolomieu/) was compared under laboratory conditions. Two hatchery-reared smallmouth bass were added to test compartments of a fiber glass trough containing five or six fish of each forage species. The common shiner was most vulnerable to predation and the hornyhead chub ranked second; the white sucker was least vulnerable. The experimental results were consistent with field observations of stomach contents of 25 smallmouth bass from the Plover River, Wisconsin. Stomachs of 12 bass contained fish and 40 percent of the identifiable fish were /Notropis/ (including the common shiner). Neither white sucker nor hornyhead chub were found in stomachs, even though the three species appeared to be about equally abundant during electrofishing operations. The difference in vulnerability demonstrated in this experiment could have resulted from such factors as innate inclination of the predator in selecting prey or the appearance and behavior of prey. It could not have resulted from previous conditioning of the predator, from variations in armament of prey, or from differences in size of prey.

76-001088 Pasch, R. W. SOME RELATIONSHIPS BETWEEN FOOD HABITS AND GROWTH OF LARGEMOUTH BASS IN LAKE BLACKSHEAR, GEORGIA. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 307-321. 1975. SFA 21(3).

[Dep. Nat. Resour., Albany, GA] The food habits and growth of 1,062 largemouth bass, /Micropterus salmoides/ (Lacpede), collected from Lake Blackshear during the period 31 March 1970-19 December 1972 were examined. Mean lengths of bass at Age I, II, III, IV, and V were 106, 253, 350, 418, and 473 mm total length, respectively. Young-of-year

76-001088 CCNTINUED

and yearling bass showed great variation in growth rates. Threadfin shad, *Dorosoma pretenense* (Gunther), and gizzard shad, *Dorosoma cepedianum* (LeSueur), were identified as the most important forage species to bass beginning their piscivorous feeding habits. The great variation in growth of young-of-year bass resulted from the timing of bass reproduction with respect to shad spawning activity. A specific goal and methods for managing largemouth bass are recommended for Lake Blackshear.

76-001089 Smith, W. E. LARVAL FEEDING AND RAPID MATURATION OF BLUEGILLS IN THE LABORATORY. Prog. Fish-Cult. 38 (2): 95-97. Apr. 1976. SFA 21(3).

[U.S. EPA, 6201 Congdon Blvd., Duluth, MN 55804] Survival of larvae of the bluegill (*Lepomis macrochirus*) reared in the laboratory was 90-93 percent when nauplii of brine shrimp (*Artemia* sp.) from San Francisco Bay (a smaller variety than that from Great Salt Lake, Utah) were used as the first food. Nauplii were fed to the larval fish within a few hours after the nauplii hatched. Bluegills hatched and reared in the laboratory spawned successfully 4-6 mo after hatching.

76-001090 Spataru, P.; Zorn, M. SOME ASPECTS OF NATURAL FEED AND FEEDING HABITS OF *TILAPIA GALILAEA* (ARTEDI) AND *TILAFIA AUREA* STEINDACHNER IN LAKE KINERET. Bamidgah 28 (1/2): 12-17. 1976. SFA 21(3).

[Fish. Aquacult. Res. Stn., Dor, Israel] *T. galilaea* is a phytophage fish. Its "favourite" feed is *Peridinium cinctum* fa vestii, an alga of the Pyrrophyta group which produces blooms in Lake Kineret and appears in great numbers 7-8 months of the year. *T. aurea*/ feed elements are extremely varied (Phytoplankton, zooplankton and zoobenthos) changing according to place and time of feeding. In contrast to *T. galilaea* which being adapted to the abiotic and biologic conditions of Lake Kineret grows and develops normally, *T. aurea*, which has been introduced relatively recently into the same ecosystem, has a slower growth rate and according to some data, does not reproduce freely in the lake.--From concl.

76-001091 Terrell, J. W.; Fox, A. C. FOCD HABITS, GRCWTH, AND CATCHABILITY OF GRASS CARP IN THE ABSENCE OF AQUATIC VEGETATION. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 251-259. 1975. SFA 21(3).

[Ga. Coop. Fish. Res. Unit., Univ. Ga., Athens 30602] Grass carp (*Ctenopharyngodon idella*) were stocked into a 3.6-ha Georgia pond devoid of vegetation to simulate conditions that might occur in a pond where grass carp have eliminated the macrophytes. The fish were readily captured by hook-and-line fishing. The stomachs of 417 grass carp contained primarily terrestrial macrophytes; no fish or fish eggs were found. Many of the grass cap examined weighed less than when they were stocked.

76-001092 Vince, S.; Valiela, I.; Backus, N.; Teal, J. M. PREDATION BY THE SALT MARSH KILLIFISH *FUNDULUS HETEROCLITUS* (L.) IN RELATION TO PREY SIZE AND HABITAT STRUCTURE: CONSEQUENCES FOR PREY DISTRIBUTION AND ABUNDANCE. J. Exp. Mar. Biol. Ecol. 23 (3): 255-266. Sept. 1976. SFA 21(3).

[Mar. Biol. Lab., Woods Hole, MA] Laboratory feeding preference experiments show that the maximum size of prey eaten (the snail *Melampus bidentatus* (Say) and the amphipod *Orchestia grillus* (Bosc)) increases with increasing size of the predator, *Fundulus heteroclitus* (L.). *Melampus* greater than 7 mm in shell height

76-001092 CONTINUED

escape predation by even the largest killifish. In the laboratory, consumption of prey is reduced in high marsh habitat relative to low marsh, particularly in the case of larger fish. Low marsh has few grass stems per unit area, while high marsh is considerably more complex, with dense small stems providing cover for prey and reducing successful fish hunting. The population of *Melampus* in low marsh within Great Sippewissett salt marsh consists mainly of large snails but this size is rare in high marsh. The size-distribution is inverse for *Orchestia*, with large amphipods more abundant in high marsh. The construction of fences excluding *Fundulus* from the marsh surface led to low marsh size-distributions of *Melampus* and *Orchestia* resembling those of high marsh, in agreement with the laboratory results. Killifish predation seems to be an important factor regulating the abundance and size-distribution of the two prey species in the two marsh habitats.

76-001093 von Geldern, C., Jr.; Mitchell, D. F. LARGEMOUTH BASS AND THREADFIN SHAD IN CALIFORNIA IN H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 436-449. 1975. SFA 21(3).

[Calif. Dep. Fish Game, Sacramento 95814]

76-001094 von Westerhagen, H.; Rosenthal, H. PREDATOR-FREY RELATIONSHIP BETWEEN PACIFIC HERRING, *CLUPEA HARENGUS PALLASI*, LARVAE AND A PREDATORY HYPERIID AMPHIPOD, *HYPEROCHE MEDUSARUM*. NOAA Fish. Bull. 74 (3): 669-674. July 1976. SFA 21(3).

[Biol. Anst. Helgoland, Zent., 2 Hamburg 50, Falmaille 9, Germany] Predatory efficiency of *Hyperocche medusarum* (Hyperiid, Amphipoda) on yolk-sac larvae of Pacific herring, *Clupea harengus pallasii*, was studied in the laboratory under continuous light conditions: 1, 5, 10, and 50 herring larvae were exposed to 1, 2, 4, 8, and 16 hyperiids in 500-ml beakers. It was found that the number of attacked larvae per unit time increased with rising predatory and/or prey density. Individual mean predation rate was found to decline with increasing predatory as well as prey densities, prolonged exposure times, and the presence of alternative prey.

AGE AND GROWTH

76-001095 Dmitrenko, E. M. SIZE-AGE COMPOSITION OF THE GIANT CATFISH, *ARIUS THALASSINUS*, IN THE VICINITY OF KATHIAWAR PENINSULA (INDIA). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (4): 622-629. 1975. SFA 21(3).

[AzherNIRO, Kerch, USSR] The giant catfish, *Arius thalassinus*, is an important fish in the northern part of the Indian Ocean. In connection with this, study of the size-age structure of its spawning stocks with subsequent clarification of the degree of influence of the catch on the abundance of the populations is of undoubted practical interest.



76-001096 Eggleston, D. DETERMINATION OF AGE OF KAHAWAI /ARRIPIS TRUTTA/ (BLOCH & SCHNEIDER). N. Z. J. Mar. Freshwater Res. 9 (3): 293-298. Sept. 1975. SFA 21(3).

[Fish. Res. Div., Minist. Agric. Fish., Wellington, New Zealand] Scales are unsuitable for age determination in /Arripis trutta/ older than 5 y (approximately equivalent to 40 cm L.C.F.). Otoliths can be used for fish of all ages. The maximum age recorded is 22 y.

76-001097 Glenn, C. L. SEASONAL GROWTH RATES OF MOONEYE (/Hiodon tergisus/) FROM THE ASSINIBOINE RIVER. J. Fish. Res. Board Can. 33 (9): 2078-2082. Sept. 1976. In English with French summ. 21(3).

[Dep. Zool., Brandon Univ., Brandon, MB R7A 6A9, Canada] Length increments, calculated from fish measured at capture and from estimates of back-calculated lengths at time of formation of the most peripheral scale annulus, were used to determine the growing season and seasonal growth rates of mooneye (/Hiodon tergisus/). Data from 670 fish indicate that mooneye grow rapidly from June to mid-August with little or no growth occurring during other months. Length increased as a linear function during summer. Summer growth rates of 0.89, 0.58, 0.49, 0.44, 0.23, and 0.16 mm/day were estimated for fish aged I-VI, respectively.

76-001098 James, G. D. SIZE COMPOSITION OF JACK MACKEREL CATCHES FROM THE WEST COAST OF NEW ZEALAND. N. Z. J. Mar. Freshwater Res. 9 (1): 45-52. Mar. 1975. SFA 21(3).

[Fish. Res. Div., Minist. Agric. Fish., P.O. Box 19062, Wellington, New Zealand] Catches of jack mackerel /Trachurus declivis/ taken every 2 months from the west coast of New Zealand show that this species attains lengths of approximately 11 cm and 24 cm at the completion of the first and second years of life respectively. Above these lengths, year classes overlap considerably. Juveniles were found from Westland to North Cape and were most abundant in surface waters.

76-001099 Lebedev, V. G. CERTAIN PECULIARITIES OF THE SIZE-AGE VARIABILITY OF THE DWARF WHITEFISH, /COREGONUS LAVARETUS NELMUSCHKA/. J. Ichthyol. (Engl. Transl. Vopr. Ikhti.) 15 (4): 664-667. 1975. SFA 21(3).

The skipping of spawning by the Cubenskoe whitefish is a rare occurrence in all age groups. Isolated large specimens ("kazarkas") in the nel'mushka dwarf whitefish population are fish of older age, of having a higher rate of growth.--From concl.

76-001100 Prentice, J. A.; Whiteside, B. G. VALIDATION OF AGING TECHNIQUES FOR LARGEMOUTH BASS AND CHANNEL CATFISH IN CENTRAL TEXAS FARM PONDS. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 414-428. 1975. SFA 21(3).

[Aquatic Stn., Southwest Texas Univ., San Marcos] A study was conducted to determine the accuracy and validity of age determination methods for largemouth bass, /Micropterus salmoides/, and channel catfish, /Ictalurus punctatus/, in central Texas farm ponds. Each pond selected for this study had been stocked only once with largemouth bass and/or channel catfish. Ages of fishes collected ranged from one through four years of age at the time of collection. Fish ages determined by the aging methods were compared to fish ages established by stocking dates. Overall accuracy of age determination made by these methods was 94 percent for largemouth bass and 77 percent for channel catfish. Accuracy of aging generally decreased as fishes became older. Indefinite annuli and supernumerary marks were found on the scales of the largemouth bass and on the fin spines of the channel catfish, but

76-001100 CONTINUED

a majority of these marks could be correctly identified. The scale and fin spine aging methods were further validated by determining the approximate time and the regularity of annulus formation. Annulus formation was found to occur from late February to mid-March for juvenile largemouth bass and from late March to early May for juvenile channel catfish. Regularity of annulus formation was indicated when total lengths were found to increase as the number of annuli found on the scales or fin spines increased, and when the calculated total lengths of fishes were found to agree with empirical total lengths of fishes at that age.

76-001101 Skillman, R. A.; Ycng, M. Y. Y. VCN BERTALANFFY GROWTH CURVES FOR STRIPED MARLIN, /TETRAPTURUS AUDAX/, AND BLUE MARLIN, /MAKAIRA NIGRICANS/, IN THE CENTRAL NORTH PACIFIC OCEAN. NCAA Fish. Bull. 74 (3): 553-566. July 1976. SFA 21(3).

[NMFS, Southwest Fish. Cent., Honolulu, HI 96812] The growth of striped marlin, /Tetrapturus audax/, and blue marlin, /Makaira nigricans/, was described by fitting von Bertalanffy growth curves (an assumed age model and a length-increment model) to the progression of age-groups, by quarters, through the Hawaiian longline fishery from 1960 to 1970. For striped marlin, the sexes grew at about the same rate and had similar predicted asymptotic maximum fork lengths, 277.4-314.4 cm for males and 288.7-362.2 cm for females. For blue marlin, the sexes grew at about the same rate until 250 cm. Above this length, the growth rate of males declined and an asymptotic maximum length of 298.8-368.0 cm was predicted. For females above 250 cm, the growth continued at a rapid rate, exhibiting little tendency toward an asymptote over the range of ages available to the study.

76-001102 Webb, J. F.; Reeves, W. C. AGE AND GROWTH OF ALABAMA SPOTTED BASS AND NORTHERN LARGEMOUTH BASS. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 204-215. 1975. SFA 21(3).

[Tenn. Wildl. Resour. Agency, Nashville]

76-001103 Woodward, R. L.; Wissing, T. E. AGE, GROWTH, AND FECUNDITY OF THE QUILLBACK (/CARPIOIDES CYPRINUS/) AND HIGHFIN (/C. VELIFER/) CARPSUCKERS IN AN OHIO STREAM. Trans. Am. Fish. Soc. 105 (3): 411-415. May 1976. SFA 21(3).

[Dep. Zool., Miami Univ., Oxford, OH 45056] An analysis of age, growth, and fecundity was carried out on 208 quillback (/Carpiodes cyprinus/) and 32 highfin (/C. velifer/) carpsuckers collected from Four Mile Creek, Ohio, May-October, 1972. Back-calculation of growth indicated that /C. cyprinus/ grows more rapidly than /C. velifer/, reaching its maximum size at age X. Males in both species were generally larger than females at each annulus, though the actual differences in length and weight were highly variable. The respective length-weight relationships for /C. cyprinus/ and /C. velifer/ were, respectively: $\log /W/ = -4.06042 + 2.78559 \log /TL/$; and $\log /W/ = -4.05206 + 2.80837 \log /TL/$; where /W/ = wet weight (g) and /TL/ = total length (mm). Monthly (May-October) condition coefficients for /C. cyprinus/ ranged from 1.13 to 1.37 for males and 1.20 to 1.24 for females. Values for /C. velifer/ (ages IV-VIII) ranged from 1.24 to 1.39. Fecundity of four /C. velifer/ (ages V-VII) ranged from 41,644 to 62,355 cva per individual. The fecundity estimates (/Fec/) (range = 15,235 to 63,779) for /C. cyprinus/ (ages IV-IX, XI; /n/ = 35) were linearly proportional to total length (/Fec/ = $-58755.7 + 2984.5 /TL/$) and age (/A/) (/Fec/ = $7172.5 + 5089.9 /A/$). A polynomial equation best described the relationship of fecundity to weight (/Fec/ = $-15690.7 + 169.1 /W/ - 0.1 /W^2/$).

GEOGRAPHICAL DISTRIBUTION, FISH SURVEYS, ETC.

76-001104 Burr, B. M. DISTRIBUTION AND TAXONOMIC STATUS OF THE STONEROLLER, /CAMPOSTOMA ANOMALUM/, IN ILLINOIS. Nat. Hist. Misc. (Chic.) No. 194. 8p. Jan. 1976. SFA 21(3).

[Ill. Nat. Hist. Surv., Urbana 61801]

76-001105 Burr, B. M.; Smith, P. W. STATUS OF THE LARGESCALE STONEROLLER, /CAMPOSTOMA OLIGOLEPIS/. Copeia 1976 (3): 521-531. Aug. 1976. SFA 21(3).

[Ill. Nat. Hist. Surv., Urbana 61801] Based on an examination of 1,450 stonerollers from throughout the upper Mississippi River valley (embracing the total range of the taxon /oligolepis/), the specific distinctiveness of /Campostoma anomalum/ and /C. oligolepis/ is confirmed. /C. anomalum/ is generally distributed throughout the entire area from central Wisconsin southward, except for localized areas where suitable habitat is lacking. /C. oligolepis/ has a disjunct range, occurring from northern Wisconsin and adjacent Minnesota and Iowa southward into central Illinois and also in the Ozarks of Missouri and Arkansas. The northern population of /oligolepis/ is rather homogeneous and differs from /anomalum/ more sharply than does the Ozark population, which shows considerable variation from drainage to drainage. In agricultural areas of Illinois and adjacent Wisconsin, Iowa, and Minnesota, /C. oligolepis/ is being supplanted by the ecologically more tolerant /C. anomalum/.

76-001106 Conner, J. V.; Bryan, C. F. REVIEW AND DISCUSSION OF BIOLOGICAL INVESTIGATIONS IN THE LOWER MISSISSIPPI AND ATCHAFALAYA RIVERS. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 429-441. 1975. SFA 21(3).

[Sch. Forest. Wildl. Manage., La. State. Univ., Baton Rouge 70803] Biological studies in the main channels of the lower Mississippi and Atchafalaya Rivers below Cairo, Illinois, were summarized and reviewed with regard to their scope, methodology, and salient findings. The study area has received much less attention than the reach above Cairo, but 67 references were found to contain at least some direct mention of lower Mississippi/Atchafalaya River biota. Fishes are the best-known and most extensively studied organisms, although few intensive, standardized studies were found. The plankton community has received the most intensive study, largely through the National Water Quality Network program. Benthic invertebrates, commercial crustaceans, and aufwuchs are the least-known organisms, although certain recent studies have revealed general community/substrate associations.

76-001107 Denoncourt, R. F.; Raney, E. C.; Hocutt, C. H.; Stauffer, J. R. A CHECKLIST OF THE FISHES OF WEST VIRGINIA. Va. J. Sci. 26 (3): 117-120. 1975. SFA 21(3).

[Dep. Biol., York Coll. Pa., York 19405] The known and expected fishes of West Virginia are documented. Seven major drainages occur in the state: the Potomac and James of the Atlantic slope; and the Monongahela, Little Kanawha, upper and lower Kanawha system, Guyandotte, and Big Sandy of the Ohio River drainage. 151 species are known from the state with an additional 18 species expected.

SPORT FISHERY ABSTRACTS

76-001108 Dudnik, Yu. I. SOME FEATURES OF THE GEOGRAPHICAL DISTRIBUTION OF THE ATLANTIC SAURY /SCOMBERESOX SAURUS/ IN THE SOUTH ATLANTIC IN WINTER. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (2): 182-189. 1975. SFA 21(3).

[VNIRO, Moscow, USSR] The limits of distribution of the Atlantic saury, /Scomberesox saurus/, in the South Atlantic are considered. Data are given on the distribution of larvae, fingerlings and juveniles of the Atlantic saury in the area extending from South America to Africa.

76-001109 Hickey, C. R., Jr.; Lester, T. E. FIRST RECORD OF THE GIZZARD SHAD FROM LONG ISLAND, NEW YORK. N. Y. Fish Game J. 23 (2): 188-189. July 1976. SFA 21(3).

[U.S. Nuclear Regulatory Comm., Washington, DC 20555]

76-001110 Hickey, C. R., Jr.; Loewen, B. A GREATER AMBERJACK FROM NEW YORK WATERS. N. Y. Fish Game J. 23 (2): 184-185. July 1976. SFA 21(3).

[U.S. Nuclear Regulatory Comm., Washington, DC 20555]

76-001111 Hickey, C. R., Jr.; Young, B. H.; Lester, J. W. TARPON FROM MONTAUK, NEW YORK. N. Y. Fish Game J. 23 (2): 186-187. July 1976. SFA 21(3).

[U.S. Nuclear Regulatory Comm., Washington, DC 20555]

76-001112 Houde, E. D.; Chitty, N. SEASONAL ABUNDANCE AND DISTRIBUTION OF ZOOPLANKTON, FISH EGGS, AND FISH LARVAE IN THE EASTERN GULF OF MEXICO, 1972-74. NOAA Tech. Rep. NMFS SSRF- 701. iii + 18p. Aug. 1976. SFA 21(3).

[Rosenstiel Sch. Mar. Atmos. Sci., Univ. Miami, 4600 Rickenbacker Causeway, Miami, FL 33149] Zooplankton volumes and abundance of fish eggs and fish larvae were determined for stations on 12 cruises to the western Florida continental shelf. Contour charts of zooplankton volumes and of ichthyoplankton abundance are presented. A marked seasonality was observed for zooplankton and ichthyoplankton, highest zooplankton volumes and ichthyoplankton abundance occurring during May through September. Zooplankton volumes were highest and spawning by fishes most intense in the northern half of the study area (north of lat. 27°15'N). Fish larvae abundance (number under 10 m² of sea surface) was highest at stations deeper than 50 m. Simple correlations among biological variables showed fish egg abundance-zooplankton volumes and fish egg abundance-fish larvae abundance to be positively correlated on most cruises. No clear relationships were observed between abundance or concentration of biological variables and temperature or salinity.

76-001113 Jenkins, R. E.; Revelle, L. A.; Zorach, T. RECORDS OF THE BLACKBANDED SUNFISH, /ENNEACANTHUS CHAETODON/, AND COMMENTS ON THE SOUTHEASTERN VIRGINIA FRESHWATER ICHTHYOFAUNA. Va. J. Sci. 26 (3): 128-134. 1975. SFA 21(3).

[Dep. Biol., Roanoke Coll., Salem, VA 24153] The blackbanded sunfish, /Enneacanthus chaetodon/, is recorded for the first time in Virginia, from the inner Coastal Plain of the Chowan system. Additional records, notably for the Roanoke, Tar, and Neuse drainages of North Carolina, supplement those of Sweeny (1972) from other parts of its range. Some of the broad gaps in its overall distribution and localization of populations probably relate to ecological factors and prehistorical changes in sea level. The freshwater ichthyofauna of

76-001113 CONTINUED

southeastern Virginia contains about 70 species. Ecological and physical barriers in the Chowan Fall Line zone apparently are not as sharp or extensive, or so restricted to that physiographic province, as in certain other Atlantic slope drainages. Thus many species typical of either the adjacent Coastal Plain or the Piedmont province occur on both sides of the Fall Line. The richness of the Chowan fauna (69 species), compared with that of the Dismal Swamp (25 species), reflects in part its greater age, closer proximity to richer faunal sources, and access to a much greater diversity of habitat.

76-001114 Kowarsky, J. CLARIFICATION OF THE NAME AND DISTRIBUTION OF THE PLOTOSID CATFISH /CNIDOGLANIS MACROCEPHALUS/. Copeia 1976 (3): 593-594. Aug. 1976. SFA 21(3).

[Thursday Is. Post Office, Queensland, Australia]

76-001115 Lee, D. S.; Norden, A.; Gilbert, C. R.; Franz, R. A LIST OF THE FRESHWATER FISHES OF MARYLAND AND DELAWARE. Chesapeake Sci. 17 (3): 205-211. Sept. 1976. SFA 21(3).

[N. Car. State Mus. Nat. Hist., 101 Halifax St., P.O. Box 27647, Raleigh 27611]

76-001116 MacCrimmon, H. R.; Robbins, W. H. DISTRIBUTION OF THE BLACK BASSES IN NORTH AMERICA. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 56-66. 1975. SFA 21(3).

[Univ. Guelph, Guelph, ON N1G 2W, Canada]

76-001117 McDowell, R. M.; Robertson, D. A.; Saito, R. OCCURRENCE OF GALAXIID LARVAE AND JUVENILES IN THE SEA. N. Z. J. Mar. Freshwater Res. 9 (1): 1-9. Mar. 1975. SFA 21(3).

[Fish. Res. Div., Minist. Agric. Fish., Wellington, New Zealand]
The occurrence of galaxiid juveniles in the sea up to 700 km from New Zealand is recorded. A total of 135 fish is recorded from 49 samples in which galaxiids occurred. Data on change in length with month of capture indicate that the marine life involves part of only one calendar year, probably 6-7 months.

76-001118 Milstein, C. B.; Thomas, D. L. FISHES NEW OR UNCOMMON TO THE NEW JERSEY COAST. Chesapeake Sci. 17 (3): 198-204. Sept. 1976. SFA 21(3).

[Ichthyological Assoc., Inc., Box 70-D, RD 2, Absecon, NJ 08201]
From March 1972 through December 1974, fishes were systematically and intensively sampled throughout the bays and ocean between Long Beach Island and Atlantic City, New Jersey. Of the 167 species taken, 13 are considered new to New Jersey while 33 are believed to be uncommon. Data are presented on these 46 species and associated oceanographic observations.

76-001119 Roberts, P. E. JUVENILE SLENDER TUNA FROM NEW ZEALAND. N. Z. J. Mar. Freshwater Res. 9 (1): 105-108. Mar. 1975. SFA 21(3).

[Fish. Res. Div., Minist. Agric. Fish., Wellington, New Zealand]
Two juvenile slender tuna /*Allothunnus fallai*/ Serventy, 278 mm and 282 mm fork length, were identified from a catch by a purse seiner 23 km off the Moko Hinai Islands, New Zealand, on 23 January 1974. As the slender tuna were observed to school in association with skipjack tuna /*Katsuwonus pelamis*/ L., it is probable that adults also school, and could be available as a yet unexploited resource to New Zealand

76-001119 CONTINUED

fishermen, especially to the south-east of New Zealand.

76-001120 Robertson, D. A. /DIPLOPHOS REBAINSI/ KREFFT & PARIN, 1972, AN ADDITION TO THE MESOPELAGIC FISH FAUNA OF NEW ZEALAND. N. Z. J. Mar. Freshwater Res. 9 (3): 411-415. Sept. 1975. SFA 21(3).

[Fish. Res. Div., Minist. Agric. Fish., P.O. Box 19062, Wellington, New Zealand] Plankton samples taken in the south-western Pacific Ocean and the Tasman Sea have provided, for the first time in these waters, a series of individuals of the gonostomatid /Diplophos rebainisi/. Observations are presented on some of the prejuvenile and adult features and on the seasonal distribution of prejuveniles off New Zealand.

76-001121 Robertson, D. A. FLANKTONIC STAGES OF THE TELEOST FAMILY CARAPIDAE IN EASTERN NEW ZEALAND WATERS. N. Z. J. Mar. Freshwater Res. 9 (3): 403-409. Sept. 1975. SFA 21(3).

[Fish. Res. Div., Minist. Agric. Fish., P.O. Box 19062, Wellington, New Zealand] The occurrence of planktonic carapid eggs in Otago waters, of young stages of /Echiodon rendahli/ cff Castlepoint, and the possible presence of unrecorded members of the family Carapidae in New Zealand waters is discussed. Young /E. rendahli/ possess a long spine which originates dorsally to a distinctive suspended gut.

76-001122 Sokolovskaya, T. S.; Sokolovskiy, A. S. NEW DATA ON EXPANSION OF THE AREA OF REPRODUCTION OF OCEAN SUNFISHES (ISCES, MOLIDAE) IN THE NORTHWESTERN PART OF THE PACIFIC OCEAN. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (4): 675-678. 1975. SFA 21(3).

[TINRO, Vladivostok, USSR]

76-001123 Sokolovskiy, A. S. THE LARVAE OF EELS OF THE FAMILY NETTASTOMIDAE (ISCES, ANGUILLIFORMES) FROM THE WATERS OF THE KUROSHIO. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (2): 325-328. 1975. SFA 21(3).

[TINRO, Vladivostok, USSR]

76-001124 Stauffer, J. R., Jr.; Hocutt, C. H.; Masnik, M. T.; Reed, J. E., Jr. THE LONGITUDINAL DISTRIBUTION OF THE FISHES OF THE EAST RIVER, WEST VIRGINIA-VIRGINIA. Va. J. Sci. 26 (3): 121-125. 1975. SFA 21(3).

[Cent. Environ. Estuarine Stud., Univ. Md., Frostburg 21532] Collections at 13 stations in the East River system, over a two-year period, produced 49 species representing 7 families. /Notropis stramineus/ was added to the ichthyofauna of Virginia. Range extensions were established for /Clinostomus funduloides/ Girard; /Ericymba buccata/ Cope; /Nocomis leptcephalus/ (Girard); /Notropis chyscephalus/ (Rafinesque); /Notropis procne/ (Cope); /Notropis telescopus/ (Cope); /Notemigonus crysoleucas/ (Mitchill); /Pimephales promelas/ Rafinesque; /Phoxinus oreas/ (Cope); /Noturus insignis/ (Richardson); and /Etheostoma caeruleum/ (Storer).

SPORT FISHERY ABSTRACTS

76-001125 Sutton, R. J. THE HUMPBAC CHUB. Colo. Outdoors 25 (4): 20-21. 1976. SFA 21(3).

ABUNDANCE, FACTORS OF; SURVIVAL AND MORTALITY

76-001126 Aggus, L. R.; Elliott, G. V. EFFECTS OF COVER AND FOOD ON YEAR-CLASS STRENGTH OF LARGEMOUTH BASS. IN H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 317-322. 1975. SFA 21(3).

[U.S. FWS, South Cent. Reservoir Invest., Fayetteville, AR]

76-001127 Clady, M. D. INFLUENCE OF TEMPERATURE AND WIND ON THE SURVIVAL OF EARLY STAGES OF YELLOW PERCH, /PERCA FLAVESCENS/. J. Fish. Res. Board Can. 33 (9): 1887-1893. Sept. 1976. In English with French summ. SFA 21(3).

[Dep. Nat. Resour., Cornell Univ., Ithaca, NY 14853] Survival from the egg to larval stage was estimated for the 1969-75 year-classes of yellow perch, /Perca flavescens/, in Oneida Lake. Egg production was determined from mark-and-recapture estimates of adult stock and measurements of fecundity, and abundance of the resulting cohort was estimated from annual larval surveys. Early survival, which varied from 1.6 to 18.4 percent was correlated positively with temperature and negatively with wind. Two variables, mean daily air temperature during the 3 weeks prior to the date the larvae attained a mean length of 8 mm and mean daily wind velocity for 4 weeks prior to this date, accounted for 87 percent of the variability in survival of perch. Physical destruction and movement of eggs by high winds and greater mortality of prolarvae caused by low temperature could account for the differences in survival between years, but do not appear severe enough to account for the 80+ percent base mortality that occurred in all years. The low year-to-year variation in survival suggests that temperature and wind influenced year-class size through a complex of many relatively minor mortality factors, rather than through one catastrophic event.

76-001128 Eipper, A. W. ENVIRONMENTAL INFLUENCES ON THE MORTALITY OF BASS EMBRYOS AND LARVAE. IN H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 295-305. 1975. SFA 21(3).

[U.S. FWS, Post Office and Courthouse, Boston, MA 02109]

76-001129 Larimore, R. W. VISUAL AND TACTILE ORIENTATION OF SMALLMOUTH BASS FRY UNDER FLOODWATER CONDITIONS. IN H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 323-332. 1975. SFA 21(3).

[Ill. Nat. Hist. Surv., Urbana 61801]

76-001130 Mathews, S. B.; Buckley, R. MARINE MORTALITY OF PUGET SOUND COHO SALMON (/ONCORHYNCHUS KISUTCH/). J. Fish. Res. Board Can. 33 (8): 1677-1684. Aug. 1976. In English with French summ. SFA 21(3).

[Coll. Fish., Univ. Wash., Seattle 98195] A model for natural mortality over the 18 mo of marine life of Puget Sound coho salmon (/Oncorhynchus kisutch/) is proposed, wherein the natural mortality rate M continuously decreases with increasing weight. Weight closely follows an increasing exponential function of marine age. The model is extended to account for ocean troll and sport fishing mortality and

76-001130 CONTINUED

applied to data from marking studies of Puget Sound coho. The survival curve for marine life with only natural mortality declines rapidly for early ocean life and is quite flat over the ages fished. Recent high survival rates for hatchery coho released at a larger than normal size could be partially explained by this mortality model, although additional marking experiments are needed to separate the effects upon survival of size at release and time of release. The model applied to hatchery release-size strategy indicates that 70 g/fish might be optimal.

76-001131 Pavlovskaya, R. M. FACTORS DETERMINING THE PRODUCTIVITY OF GENERATIONS OF PELAGOPHILIC SUMMER-SPAWNING FISHES OF THE BLACK SEA. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (4): 570-578. 1975. SFA 21(3).

[AzherNIRO, Kerch, USSR] The conditions of reproduction have been investigated and the reasons for different productivity of generations of the principal, commercial, summer-spawning fishes of the Black Sea are explored. Analysis has been made of the influence of the abundance of the spawning stock, the fecundity of the broodfish, spawn quality and environmental factors on the productivity of fish generations.

76-001132 Pflieger, W. L. REPRODUCTION AND SURVIVAL OF THE SMALLMOUTH BASS IN COURTOIS CREEK. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 231-239. 1975. SFA 21(3).

[Mo. Dep. Conserv., Columbia 65201]

76-001133 Rainwater, W. C.; Houser, A. RELATION OF PHYSICAL AND BIOLOGICAL VARIABLES TO BLACK BASS CROPS. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 306-309. 1975. SFA 21(3).

[U.S. FWS, South Cent. Reservoir. Invest., Fayetteville, AR]

76-001134 Summerfelt, R. C. RELATIONSHIP BETWEEN WEATHER AND YEAR-CLASS STRENGTH OF LARGEMOUTH BASS. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 166-174. 1975. SFA 21(3).

[Okla. Coop. Fish. Res. Inst., Okla. State Univ., Stillwater 74074]

76-001135 Swenson, W. A.; Smith, L. L., Jr. INFLUENCE OF FOOD COMPETITION, PREDATION, AND CANNIBALISM ON WALLEYE (/STIZOSTEDION VITREUM VITREUM/) AND SAUGER (/S. CANADENSE/) POPULATIONS IN LAKE OF THE WOODS, MINNESOTA. J. Fish. Res. Board Can. 33 (9): 1946-1954. Sept. 1976. In English with French summ. SFA 21(3).

[Dep. Biol., Univ. Wis., Superior 54880] Feeding relationships between walleye, /Stizostedion vitreum vitreum/, and sauger, /Stizostedion canadense/, in Lake of the Woods, Minnesota, were investigated. Effectiveness of food consumption estimates in measuring feeding interactions was defined. Differences in walleye and sauger distribution, food habits, and feeding strata reduced interactions. Walleye feeding rate varied from 0.5 to 4.1 percent of body weight per day and was limited by prey abundance during June and July. Higher August and September prey densities did not influence walleye food consumption. Daily food consumption of sauger varied from 0.5 to 3.5 percent of body weight independent of changes in food availability. Relationships between the number of prey consumed daily by walleye and sauger and the decline in abundance of prey species suggested that predation was important in controlling food availability, and was the

76-001135 CONTINUED

major cause of food competition and its limiting effect on walleye growth. Analysis of commercial catch statistics suggested that factors other than predation influenced walleye survival. However, the relationship between the number of young-of-the-year walleye consumed and their abundance in the lake demonstrated predation by sauger may be important to walleye survival.

IDENTIFICATION, KEYS, CLASSIFICATION

76-001136 Able, K. W. A NEW CYCLOPTERID FISH /LIPARIS COHENI/ FROM THE WESTERN NORTH ATLANTIC WITH NOTES ON LIFE HISTORY. Copeia 1976 (3): 515-521. Aug. 1976. SFA 21(3).

[Biol. Dep., McGill Univ., Montreal, PQ, Canada] A new species of Cyclopterid fish, /Liparis coheni/, differs from its congeners in the numbers of fin rays and pyloric caeca. This species has been collected in the Gulf of Maine, off southern Nova Scotia and in the Gulf of St. Lawrence. /Liparis coheni/ may spawn as it is entering its second year. The planktonic larvae are abundant in estuaries in the northwestern Gulf of Maine during winter and early spring.

76-001137 Faber, D. J. IDENTIFICATION OF FOUR NORTHERN BLENNIOID FISH LARVAE IN THE CANADIAN ATLANTIC OCEAN (STICHAETIDAE, LUMPENIDAE). J. Fish. Res. Board Can. 33 (8): 1798-1802. Aug. 1976. In English with French summ. SFA 21(3).

[Natl. Mus. Canada, Can. Aquatic Ident. Cent., Ottawa, CN K1A 0M8, Canada] Four similar northern blenniid fish larvae from the Gulf of St. Lawrence can be identified on the basis of morphological features. The two larvae of the family Stichaeidae, /Ulvaria subtifurcata/ and /Stichaeus punctatus/, can be distinguished from the two larvae of the family Lumpenidae, /Leptoclinus maculatus/ and /Lumpenus lampretaeformis/, by total myomere counts, the position of intestinal myomeres, presence or absence of head melanophores, and presence or absence of internal melanophores along the abdominal part of the notochord. The identification of individual species is based mainly on myomere counts and ventromedial melanophore counts.

76-001138 Fedorov, V. V. DESCRIPTION OF A NEW GENUS AND SPECIES OF A ZOARCID FISH /PUZANOVIA RUBRA/, GEN. ET SP. N. (PISCES, ZOARCIDAE) FROM THE NORTHERN PART OF THE PACIFIC OCEAN. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (4): 527-531. 1975. SFA 21(3).

[TINRO, Vladivostok, USSR] A new genus and species /Puzanovia rubra/ gen. et sp. n. (Zoarcidae), which lives at depths of 200-610 m amid the dendritic coral /Primnoa resedaeformis/ f. /pacificus/ is described from the Bering and Okhotsk Seas and from the Pacific Ocean side of the Kurile Islands.

76-001139 Hoese, D. F.; Brothers, E. B. /PARATRIMMA/, A NEW GENUS OF GOBIID FISHES AND TWO NEW SPECIES. Copeia 1976 (3): 494-497. Aug. 1976. SFA 21(3).

[Dep. Ichthyol., Australian Museum, Sydney, Australia] /Paratrimma/ is described as a new genus of gobiid fish from the Juan Fernandez and San Felix Islands off Chile. Two new species, /P. nigrimenta/ and /P. urospila/, are described. The new genus is most closely related to /Lythrypnus/ and /Trimma/, but differs in several features.

76-001140 Larson, H. K. A NEW SPECIES OF /EVIOTA/ WITH DISCUSSION OF THE NOMINAL GENERA /EVIOTA/ AND /EVIOTOPS/. Copeia 1976 (3): 498-502. Aug. 1976. SFA 21(3).

[Australian Museum, 6-8 College Street, Sydney, Australia 2000] A new species of /Eviota/ (Gobiidae), with unbranched pectoral rays, is described. The characteristics previously used to distinguish /Eviotops/ from /Eviota/ are shown to be inadequate to justify generic separation. /Eviotops/ is regarded here as a synonym of /Eviota/.

76-001141 Page, L. M.; Smith, P. W. VARIATION AND SYSTEMATICS OF THE STRIPETAILED DARTER, /ETHEOSTOMA KENNICOTTI/. Copeia 1976 (3): 532-541. Aug. 1976. SFA 21(3).

[Ill. Nat. Hist. Surv., Urbana 61801] A morphological examination was made of 469 specimens of /Etheostoma kennicotti/ from throughout the range of the species. Four characters were found to be sexually dimorphic, and six characters were found to vary allometrically. Five characters showed clinal geographic variation with specimens from the Cumberland River system at one end of the cline and specimens from Illinois and northwestern Kentucky at the other end. Distinct intraspecific populations are not recognizable and use of the subspecific name, /E. k. cumberlandicum/, should be discontinued. The distribution of /E. kennicotti/ appears to be related to the distribution of other species of the subgenus /Catonotus/.

76-001142 Pertseva-Ostroumova, T. A. LARVAE OF THE LANTERNFISH, /DIAPHUS AGASSIZI/ (MYCTOPHIDAE, PISCES). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (4): 606-610. 1975. SFA 21(3).

[Inst. Oceanol., Acad. Sci., Moscow, USSR]

Larvae of /Diaphus agassizi/ with a length of 3.5-11.0 mm caught in the northwestern part of the Pacific Ocean are described for the first time. The larvae are small, pigmented weakly, and their metamorphosis is completed at a length of around 11 mm.

76-001143 Ramsey, J. S. TAXONOMIC HISTORY AND SYSTEMATIC RELATIONSHIPS AMONG SPECIES OF /MICROPTERUS/. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 67-75. 1975. SFA 21(3).

[Ala. Coop. Fish. Res. Unit, Auburn, AL 36830]

76-001144 Rosen, D. E.; Greenwood, P. H. A FOURTH NEOTROPICAL SPECIES OF SYNBRANCHID EEL AND THE PHYLOGENY AND SYSTEMATICS OF SYNBRANCHIFORM FISHES. Bull. Am. Mus. Nat. Hist. 157 (1): 1-69. 1976. SFA 21(3).

[Am. Mus. Nat. Hist., Central Park W. at 79th St., New York, NY 10024] The discovery of an undescribed species of synbranchiform eel, with populations in the Atlantic slope of Mexico, Guatemala, Honduras, Cuba, and northeastern South America, presented problems in its taxonomic assignment that required a review of the genera and higher groups within the order. A phylogenetic hypothesis is put forward that divides all synbranchiforms (treated here as the single family Synbranchidae) into two lineages: the Macrotreminiae and the Synbranchinae. The nomenclatural histories of the genera and some species are discussed and an analytical key to the subfamilies, genera, and species is provided.--From abstr.

76-001145 Rosenblatt, R. H.; Montgomery, W. L. /KRYPTOPHANERON HARVEYI/, A NEW ANOMALOPID FISH FROM THE EASTERN TROPICAL PACIFIC, AND THE EVOLUTION OF THE ANOMALOPIDAE. Copeia 1976 (3): 510-515. Aug. 1976. SFA 21(3).

[Scripps Inst. Oceanogr., Univ. Calif., La Jolla 90024]

76-001146 Seshagiri Rao, B. V. NOTES ON THE INDO-WEST PACIFIC SPECIES OF THE CLUPEID FISH GENUS /ILISHA/, WITH A KEY TO THEIR IDENTIFICATION. Copeia 1976 (3): 503-509. Aug. 1976. SFA 21(3).
[Dep. Zool., D.N.R. Coll., Bhimavaram 534202, Andhra Pradesh, India]
Indo-Pacific members of the tropical clupeid fish genus /Ilisha/ are reviewed, based on material from the Bay of Bengal. Two species, /I. filigera/ and /I. elongata/, are redescribed. A key is provided to all the species of the Indo-West Pacific region.

76-001147 Shen, S.-C.; Choi, Y.-H. ECOLOGICAL AND MORPHOLOGICAL STUDY ON FISH-FAUNA FROM THE WATERS AROUND TAIWAN AND ITS ADJACENT ISLANDS. 16. STUDY ON THE LABRID FISHES (LABRIDAE). Rep. Inst. Fish. Biol. Minist. Econ. Off. Natl. Taiwan Univ. III (2): 67-106. July 1976. SFA 21(3).

[Dep. Zool., Natl. Taiwan Univ., Taipei 107, Taiwan, Republic of China] The family of Labridae is reviewed from Taiwan and its adjacent islands. Ninety-six species, including three doubtful species, belonging to twentyeight genera and four subfamilies are recognized. Most species are studied and compared by using living, fresh or preserved specimens to present information on certain difficult-to-identify species and also to give a key of species (including their primary, terminal and sexually dichromatic color phases, if any), genera and subfamilies currently recognized.

76-001148 Weinstein, M. P.; Yerger, R. W. PROTEIN TAXONOMY OF THE GULF OF MEXICO AND ATLANTIC OCEAN SEATROUTS, GENUS /CYNOSCION/. NOAA Fish. Bull. 74 (3): 599-607. July 1976. SFA 21(3).

[Lawler, Matusky & Shelly Eng., 415 Rt. 303, Tappan, NY 10983]
Taxonomic relationships among the western North Atlantic seatrouts, genus /Cynoscion/, were investigated utilizing acrylamide gel electrophoresis. Several tissues (blood serum, eye lens, and muscle) were incorporated in this study to gain a better taxonomic overview than would be attainable with a single protein system. Blood serum exhibited considerable variation in banding patterns. Because direct interspecific comparisons were not possible, a phenetic analysis was employed. Eye lens and muscle patterns, however, were directly comparable. Based on the overall results, three taxonomic conclusions may be drawn. First, with the exception of a single taxonomic distance (/d(jk)/) value calculated in the phenetic analysis, the relationships established by electrophoresis reflect the phyletic relationships proposed by Ginsburg. This "aberrant" value is believed to result from the small sample size and the possibility of ecological convergence. Second, the data indicate that /Cynoscion nebulosus/ is the most divergent of the four forms, supporting previous morphological and ecological conclusions. Third, as suggested by previous studies, the taxonomic status of /C. arenarius/ as a distinct species is again questioned. Electrophoretic patterns indicate that it should be regarded as a subspecies of /C. regalis/.

PARASITES AND DISEASES-GENERAL

76-001149 Mitenev, V. K.; Zubchenko, A. V. THE PARASITIC FAUNA OF THE WHITEFISH /COREGONUS LAVARETUS/ FROM SCME BODIES OF WATER OF THE KOLA PENINSULA. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (2): 320-324. 1975. SFA 21(3).

[PINRO, Murmansk, USSR] Data are presented on the parasitic fauna of the whitefish, /Coregonus lavaretus/, from the basins of the Ponony, Pyalitsa and Varzuga rivers of the Kola Peninsula. Altogether 38 species of parasites were found. A number of ecological features of the whitefish (feeding, migration, local stocks) were established.

76-001150 Sullivan, J. R. SOME DISEASES OF THE BLACK BASSES. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 95-103. 1975. SFA 21(3).

[Dep. Fish., Auburn Univ., Auburn, AL 36830]

BACTERIAL DISEASES

76-001151 Khalifa, K. A.; Post, G. IMMUNE RESPONSE OF ADVANCED RAINBOW TROUT FRY TO /AEROMONAS LIQUIFACIENS/. Prog. Fish-Cult. 38 (2): 66-68. Apr. 1976. SFA 21(3).

[Dep. Fish. Wildl. Biol., Colo. State Univ., Fort Collins 80523] Antibody synthesis against /Aeromonas liquefaciens/ antigen was demonstrated in the fry of rainbow trout (/Salmo gairdneri/) vaccinated intraperitoneally at 23 days from swim-up. Fish weighing approximately 0.3 g produced antibodies when tested 21-30 days after injection. Antibody titers persisted for 3 1/2 to 8 months after injection, depending on whether the antigen was suspended in saline or in Freund's complete adjuvant. Immunization was protective against homologous viable bacterial cells.

76-001152 Shireman, J. V.; Colle, D. E.; Rottman, R. W. INCIDENCE AND TREATMENT OF COLUMNARIS DISEASE IN GRASS CARP BROOD STOCK. Prog. Fish-Cult. 38 (2): 116-117. Apr. 1976. SFA 21(3).

[Sch. Forest Resour. Conserv., Univ. Fla., Gainesville 32611] According to the literature, grass carp (/Ctenopharyngodon idella/) have a rather rich parasitic fauna; however, columnaris disease has not been reported. From 9 May through 14 July 1975, spawn was collected from 42 brood fish; 34 percent of these fish died from columnaris disease. After positive identification of the disorder, 12 fish were dipped in a 2-min bath of copper sulfate solution (500 mg/l). Although the treatment was rigorous it was an effective treatment for columnaris in grass carp.



PROTOZOAN DISEASES

76-001153 Hine, P. M. /EIMERIA ANGUILLAE/ LEGER & HOLLANDE, 1922 PARASITIC IN NEW ZEALAND EELS. N. Z. J. Mar. Freshwater Res. 9 (2): 239-243. June 1975. SFA 21(3).

[Fish. Res. Div., Minist. Agric. Fish., P.O. Box 19062, Wellington, New Zealand] /Eimeria anguillae/ Leger & Hollande, 1922 (Sporozoa: Coccidia) is recorded from /Anguilla australis/ Richardson, 1848 and /A. dieffenbachii/ Gray, 1842 introduced as elvers into a New Zealand eel farm. The parasite is identified by the hexagonal cross section of the sporocysts, dimensions, and lack of asexual and early sexual stages in the mucosal and submucosal tissues. Discrepancies in previously published details of the micropyle and sporocyst vestigial body are attributed to the limitations of earlier microscopes. In heavy infections the mucosa and submucosa are partially or totally destroyed, and both oocysts and sporocysts are passed out with necrotic tissue.

VIRAL DISEASES

76-001154 Williams, I. V.; Amend, D. F. A NATURAL EPIZOOTIC OF INFECTIOUS HEMATOPOIETIC NECROSIS IN FRY OF SOCKEYE SALMON (/ONCORHYNCHUS NERKA/) AT CHILKO LAKE, BRITISH COLUMBIA. J. Fish. Res. Board Can. 33 (7): 1564-1567. July 1976. In English with French summ. SFA 21(3).

[Int. Pac. Salmon Fish. Comm., Cultus Lake, BC VOX 1H0, Canada] The first confirmed epizootic of infectious hematopoietic necrosis virus disease under natural conditions is reported for sockeye salmon, /Oncorhynchus nerka/, in Chilko Lake, British Columbia. The outbreak occurred among fish of the 1972 brood during the spring of 1973. An estimated 825.6 million eggs were deposited in the Chilko River in 1972, and the production of 31.4 million fry that migrated into the lake in 1973 was significantly lower than the 55.1 million fry expected. The egg-to-fry survival of 3.8 percent was the lowest ever recorded at Chilko Lake (1949-73). The estimated fry-to-smolt survival of 57.1 percent, however, was well within the normal range for this lake. Apparently IHN severely reduced the survival of the 1972 brood of sockeye salmon fry at Chilko Lake, and all or nearly all of the reduction occurred during the egg-to-fry stage of the life cycle.

OTHER DISEASES AND PARASITES

76-001155 Buttner, J. K.; Hamilton, R. W. /ERGASILUS/ (COPEPODA: CYCLOPOIDA) INFESTATION OF COHO AND CHINOOK SALMON IN LAKE MICHIGAN. Trans. Am. Fish. Soc. 105 (3): 491-493. May 1976. SFA 21(3).

[Dep. Zool., South. Ill. Univ., Carbondale 62901] Parasitic copepods were found on 1.6 percent of coho salmon, /Oncorhynchus kisutch/, 8.8 percent of chinook salmon, /Oncorhynchus tshawytscha/, and 15.8 percent of yellow perch, /Perca flavescens/, from Lake Michigan. /Ergasilus luciopercarum/ Henderson parasitized chinook salmon and yellow perch, while /Ergasilus nerkae/ Roberts was observed only on coho salmon. /E. luciopercarum/ was also found to parasitize rainbow trout, /Salmo gairdneri/ Richardson, and brown trout, /Salmo trutta/ Linnaeus. This is the first report of /E. luciopercarum/ parasitizing the above salmonids and /E. nerkae/ parasitizing coho salmon.

76-001156 Chung, H.-Y.; Kou, G.-H. A SPONTANEOUS EPITHELIOMA IN THE COLOR CARP (*CYPRINUS CARPIO*/ L.). Rep. Inst. Fish. Biol. Minist. Econ. Off. Natl. Taiwan Univ. III (2): 1-3. July 1976. SFA 21(3).

[Dep. Zool., Coll. Sci., Natl. Taiwan Univ., Taipei, Taiwan, Republic of China] A spontaneous, malignant, non-metastatic epithelioma (epidermoid carcinoma) was found in the head region of a color carp, *Cyprinus carpio*/ L. The tumor was similar in many respects to that of the skin epitheliomas of mammals and other vertebrates. This is the first case found in the fish belonging to *Cyprinus carpio*/ L.

76-001157 Ebel, W. J.; Raymond, H. L. EFFECT OF ATMOSPHERIC GAS SUPERSATURATION ON SALMON AND STEELHEAD TROUT OF THE SNAKE AND COLUMBIA RIVERS. Mar. Fish. Rev. 38 (7): 1-14. July 1976. SFA 21(3).

[NMFS, Northwest Fish. Cent., 2725 Montlake Blvd. East, Seattle, WA 98112] Laboratory and field research data defining the effects of supersaturation of atmospheric gas on fish (primarily salmonids, in the Columbia River are summarized. Recent bioassay information regarding effects of various levels of supersaturation on several species of salmonids are compared with observations obtained in the river. The severity of the effect of supersaturation was dependent on level of supersaturation, the duration of exposure, water temperature, general physical condition of the fish, and the swimming depth maintained by the fish. Mortality caused by supersaturation was estimated for each of several years from 1966-74.

76-001158 Esch, G. W.; Campbell, G. C.; Conners, R. E.; Coggins, J. R. RECRUITMENT OF HELMINTH PARASITES BY BLUEGILLS (*LEPOMIS MACROCHIRUS*) USING A MODIFIED LIVE-BOX TECHNIQUE. Trans. Am. Fish. Soc. 105 (3): 486-490. May 1976. SFA 21(3).

[Dep. Biol., Wake Forest Univ., Winston-Salem, NC 27109] A modification of the live-box technique was used in studying the recruitment of helminth parasites by bluegills, *Lepomis macrochirus*/, during the summer of 1973-74 in Gull Lake, Kalamazoo County, Michigan. Simultaneously, an approximately even number of *L. macrochirus*/ were captured by hook and line and the parasite fauna compared with that of tethered bluegills. The results show that the nature of the parasite faunas in the two groups of fish is similar. Results of tether experiments indicate that the acanthocephalan, *Pomphorhynchus bulbocolli*/, was recruited at a higher rate early in the summer, then declined while *Leptorhynchoides thecatus*/ was initially recruited slowly, then increased as *P. bulbocolli*/ was declining. The spatial distribution of *L. thecatus*/ indicated a preference for the ceca and anterior two-thirds of the intestine while *P. bulbocolli*/ localized most frequently in the anterior two-thirds of the intestine. While there was a zone of overlap for the two species, there was no indication of competitive exclusion after comparing single versus mixed infections of the two species.

76-001159 Hewitt, G. C. NEW NAME FOR SOME *CONGERICOLA*/ (PARASITIC COPEPODA) FROM NEW ZEALAND CONGER EELS. N. Z. J. Mar. Freshwater Res. 9 (4): 563-565. Dec. 1975. SFA 21(3).

[Dep. Zool., Victoria Univ. Wellington, Private Bag, Wellington, New Zealand] Specimens of *Congericola*/ from a New Zealand conger eel, *Conger verreauxi*/ which were previously described as *Congericola pallidus*/ Beneden, are placed in a new species, *Congericola kabatai*/ in the basis of the possession of a four-segmented first antenna, a two-segmented exopod in the third pereopod, the presence of spines on

76-001159 CONTINUED

the fourth pereopod, and other differences in ornamentation of the pereopods which separate it from the closely related species */Congericola pallidus/*.

76-001160 Khalifa, K. A.; Post, G. HISTOPATHOLOGICAL EFFECT OF */LERNAEA CYPRINACEA/* (A COPEPOD PARASITE) ON FISH. Prog. Fish-Cult. 38 (2): 110-113. Apr. 1976. SFA 21(3).

[Dep. Fish. Wildl. Biol., Colo. State Univ., Fort Collins 80523] The gross and microscopic effects of */Lernaea cyprinacea/* on four species of fish were studied. Lesions caused by the parasite first appeared as small petechiae that increased in diameter as the parasite grew. The tissue around the parasite became raised, hemorrhagic, and, in advanced cases, necrotic. Host response was a typical inflammatory reaction, with the body of the parasite usually becoming surrounded by connective tissue. Extensive destruction of dermal and muscle tissues and of internal organ tissues occurred as the anchor process of the parasites became more deeply imbedded; anchor processes were found in all vital organs except the kidneys.

76-001161 Nebeker, A. V.; Bouck, G. R.; Stevens, D. G. CARBON DIOXIDE AND OXYGEN-NITROGEN RATIOS AS FACTORS AFFECTING SALMON SURVIVAL IN AIR-SUPERSATURATED WATER. Trans. Am. Fish. Soc. 105 (3): 425-429. May 1976. SFA 21(3).

[U.S. EPA, 1350 S.E. Goodnight Ave., Corvallis, OR 97330] Juvenile sockeye salmon (*/Oncorhynchus nerka/*) were exposed to lethal levels of air-supersaturated water (120 percent, 125 percent, 130 percent total gas saturation) containing different oxygen-nitrogen ratios and different carbon dioxide concentrations. Fish mortality was not significantly different at different carbon dioxide levels (1.7 to 22.0 mg/liter CO₂) when tested at the same total gas saturation concentrations. Total gas saturation levels are much more important than the O₂/N₂ ratios, as fish mortality will not occur unless total gas saturation exceeds 100 percent, regardless of the O₂/N₂ ratios. There was a significant decrease in mortality when the ratio of oxygen to nitrogen was increased while holding the total percent saturation constant. Much more extensive and severe signs of gas bubble disease developed at high O₂/N₂ ratios than at low O₂/N₂ ratios, indicating that oxygen plays a significant part in forming external emphysema and lesions.

76-001162 Oishi, K.; Yamazaki, F.; Harada, T. EPIDERMAL PAPILLOMAS OF FLATFISH IN THE COASTAL WATERS OF HOKKAIDO, JAPAN. J. Fish. Res. Board Can. 33 (9): 2011-2017. Sept. 1976. In English with French summ. SFA 21(3).

[Fac. Fish., Hokkaido Univ., Hokodate, Japan] In eastern parts of Hokkaido Island, Japan, epidermal lesions have been frequently found on flatfish. These were diagnosed as papillomas resulting from an abnormal proliferation of epidermal cells and were found on both the eyed and eyeless sides. Some of the cells were hypertrophied and irregularly shaped. Mucus secretion was decreased and there was only a weak reaction to periodic acid-Schiff (PAS) staining. A possible association between a blood-red parasite, probably */Philometra mariae/*, and the development of the tumorous tissue was examined. The ratios of tumorous fish to total catch were 60:724 (8.29 percent) in inlets, and 43:12,600 (0.34 percent) in areas facing a strait. */Philometra/* infection rates were 80:225 (35.6 percent) in the inlets, and 41:2,521 (1.63 percent) in the latter areas.

SPORT FISHERY ABSTRACTS

76-001163 Stich, H. F.; Acton, A. B.; Forrester, C. R. FISH TUMORS AND SUBLETHAL EFFECTS OF POLLUTANTS. J. Fish. Res. Board Can. 33 (9) 1993-2001. Sept. 1976. In English with French summ. SFA 21(3).

[Cancer Res. Cent., Univ. British Columbia, Vancouver, BC V3T 1W5, Canada] The feasibility of using fish tumors as an early, economic, and sensitive warning system for carcinogens in marine environments was examined. Two different tumor-fish systems were chosen: 1) papillomas among bottom-dwelling flatfish (Pleuronectidae) and 2) bilateral parabranchial tumors of the free-swimming Pacific cod (*Gadus macrocephalus*). Tumor prevalence can reach 58 percent among young English sole (*Parophrys vetulus*) and up to 100 percent in young cod populations. Tumor prevalence varies greatly (0.1-100 percent) in fish populations in various geographic locations. The possibility of involvement of virus and chemical carcinogens and the ease of screening large numbers seem to make fish tumors an ideal model of a situation that could easily develop in human populations within the foreseeable future.

76-001164 Wobeser, G.; Kratt, L. F.; Smith, E. J. F.; Acompanado, G. PROLIFERATIVE FRANCHIITIS DUE TO *TETRAONCHUS RAUSCHI* (TREMATODA: MONOGENEA) IN CAPTIVE ARCTIC GRAYLING (*THYMALLUS ARCTICUS*). J. Fish. Res. Board Can. 33 (8): 1817-1821. Aug. 1976. In English with French summ. SFA 21(3).

[Dep. Vet. Pathol., Univ. Saskatchewan, Saskatoon, SK S7N 0W0, Canada] The monogenetic trematode *Tetraonchus rauschi* was diagnosed as the cause of severe proliferative and inflammatory gill disease among captive Arctic grayling (*Thymallus arcticus*). Grayling captured from the wild had few flukes and very limited pathologic lesions when compared to captive fish.

POLLUTION

76-001165 Anonymous THE FIRST INTERNATIONAL SYMPOSIUM ON ACID PRECIPITATION AND THE FOREST ECOSYSTEM. PROGRAM AND ABSTRACTS. Atmos. Sci. Prog., Ohio State Univ., Columbus. iii + 69p. July 1975. Available at \$4.00 from Engineering Exp. Stn., Ohio State Univ., 2070 Neil Ave., Columbus, OH 43210. SFA 21(3).

Abstracts of about 80 papers. (RS)

76-001166 Collins, J. OIL AND GREASE: A PROPOSED ANALYTICAL METHOD FOR FISHERY WASTE EFFLUENTS. NOAA Fish. Bull. 74 (3): 681-683. July 1976. SFA 21(3).

[NMFS, Pac. Util. Res. Cent., P.O. Box 1638, Kodiak, AK 99615]

76-001167 Hargrave, B. T.; Phillips, G. A. DDT RESIDUES IN BENTHIC INVERTEBRATES AND DEMERSAL FISH IN ST. MARGARET'S BAY, NOVA SCOTIA. J. Fish. Res. Board Can. 33 (8): 1692-1698. Aug. 1976. In English with French summ. SFA 21(3).

[Dep. Environ., Fish. Mar. Serv., Bedford Inst. Oceanogr., Dartmouth, NS B2Y 4A2, Canada] Organochlorine residues (p,p'-DDT and its metabolites) were measured in samples of benthic invertebrates and demersal fish taken from St. Margaret's Bay, Nova Scotia. No other organochlorine compounds were present in detectable amounts. [Total] DDT levels in whole organisms, excluding lipid-rich tissues, grouped as benthic epifauna, infauna, and demersal fish were not significantly different and thus no accumulation occurs in this food chain. Atmospheric supply is probably the major source of low levels of

76-001167 CONTINUED

contamination and a detritus-based food web may equalize residue concentration between various feeding types.

76-001168 Hill, D. M.; Taylor, E. A.; Saylor, C. P. STATUS OF FAUNAL RECOVERY IN THE NORTH FORK HOLSTON RIVER, TENNESSEE AND VIRGINIA. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 398-413. 1975. SFA 21(3).

[TVA, Norris, TN] Two years after pollution abatement, faunal communities in the North Fork Holston River below Saltville, Virginia, remain in a perturbed condition. The number of fish species is increasing at the lower downstream stations, but show little change immediately downstream of Saltville. Two species which occur regularly above Saltville were not taken at any downstream station during this study. The abundance and diversity of aquatic insects at downstream stations are extremely variable, but are generally less below Saltville than they are upstream. Populations of mussels have not been successful in recolonizing downstream areas. Water quality parameters fall within acceptable ranges for healthy aquatic communities, but an analysis of river sediments documents the existence of high mercury concentrations. The relatively slow rate of natural recovery processes can probably be attributed to the continuing input of toxic materials from the abandoned waste lagoons.

76-001169 Hurlbert, S. H. SECONDARY EFFECTS OF PESTICIDES ON AQUATIC ECOSYSTEMS. Residue Rev. 58: 81-148. 1975. SFA 21(3).

[Dep. Biol., San Diego State Univ., San Diego, CA 92115] Primary effects of pesticides are defined as direct effects on the growth, survival, and reproduction of organisms. Ecological consequences of these primary effects are termed secondary effects and the literature on these is reviewed for aquatic systems. Topics treated include: stimulation of algal populations by insecticides, sequelae of herbicide treatments, alteration of physical-chemical environment, prey increase following predator removal, and so on.

76-001170 Primmer, K. W.; Clugston, J. P. EFFECTS OF EFFLUENTS FROM TROUT HATCHERIES ON THE BENTHOS AND FISH IN RECEIVING STREAMS. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 332-342. 1975. SFA 21(3).

[Ga. Dep. Nat. Resour., Calhoun] This study evaluated the effects of discharges from three southeastern trout hatcheries on the benthic organisms and fish in the receiving streams. The U.S. Fish and Wildlife Service hatcheries were at Suches, Georgia; Walhalla, South Carolina; and Brevard, North Carolina. Although effects differed somewhat for each hatchery, the numbers and kinds of both benthos and fish generally increased immediately downstream from the hatchery outfalls. Pollution intolerant benthic organisms were not lost from the fauna below the hatchery outfalls. No detrimental changes in the fish communities were apparent.

76-001171 Siler, J. R.; Clugston, J. P. LARGEMOUTH BASS UNDER CONDITIONS OF EXTREME THERMAL STRESS. IN H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 333-341. 1975. SFA 21(3).

[Duke Power Environ. Lab., Huntersville, NC]

76-001172 Vandermeulen, J. H.; Gordon, D. C., Jr. REENTRY OF 5-YEAR-OLD STRANDED BUNKER C FUEL OIL FROM A LOW-ENERGY BEACH INTO THE WATER, SEDIMENTS, AND BIOTA OF CHEDABUCTO BAY, NOVA SCOTIA. J. Fish. Res. Board Can. 33 (9): 2002-2010. Sept. 1976. In English with French summ. SFA 21(3).

[Dep. Environ., Fish. Mar. Serv., Mar. Ecol. Lab., Bedford Inst. Oceanogr., Dartmouth, NS B2Y 4A2, Canada] Large amounts of Bunker C fuel oil remain stranded along the shoreline of Chedabucto Bay, Nova Scotia, 5 yr after the grounding of the Liberian tanker /Arrow/. This stranded oil is not static, but is slowly being released to the littoral and sublittoral environments. However, only trace amounts enter the tidal water column directly. The main route of reentry appears to be via the sediments and the interstitial water. A parallel distribution to the low tidal-high interstitial oil distribution is found in tissue-bound oil in beach biota. High levels of Bunker C equivalents were found in the burrowing clam /*Mya arenaria*/ and the rooted eelgrass /*Zostera*/ sp. Such epibenthic organisms as the macroalga /*Fucus*/ sp. contained no evidence of oil contamination. Very low levels were indicated in the mussel /*Mytilus edulis*/. Beach sediments appear to act as a natural sink, sequestering interstitial oil (up to 10 mg oil/g sediment). Sediment-bound oil has a long residence time, and flow experiments indicate that stranded oil will remain in excess of 150 years.

76-001173 Waldichuk, M. (ed.) POLLUTION SYMPOSIUM--13TH PACIFIC SCIENCE CONGRESS: SUBLETHAL EFFECTS OF POLLUTION ON AQUATIC ORGANISMS. J. Fish. Res. Board Can. 33 (9): 1985-2065. Sept. 1976. In English with French summ. SFA 21(3).

[Dep. Environ., Fish. Mar. Serv., Pac. Environ. Inst., West Vancouver, BC V7V 1N6, Canada] A collection of 10 papers. (RS)

76-001174 Walker, C. R. POLYCHLORINATED BIPHENYL COMPOUNDS (PCB'S) AND FISHERY RESOURCES. Fisheries (Bull. Am. Fish. Soc.) 1 (4): 19-22, 25. July-Aug. 1976. SFA 21(3).

[U.S. FWS, Office Biol. Serv., Washington, DC 20240]

TOXICOLOGY; BIOASSAYS

76-001175 Abdullah, M. I.; Banks, J. W.; Miles, D. L.; O'Grady, K. T. ENVIRONMENTAL DEPENDENCE OF MANGANESE AND ZINC IN THE SCALES OF ATLANTIC SALMON, /*SALMO SALAR*/ (L) AND BROOK TROUT, /*SALMO TRUTTA*/ (L). Freshwater Biol. 6 (2): 161-166. Apr. 1976. SFA 21(3).

[Dep. Oceanogr., Crown St., P.O. Box 147, Liverpool L69 3EX, England] Analysis of manganese and zinc concentrations in the scales of salmon and trout from a number of sites showed significant dependence of the levels of these metals in the scales on the levels in the environment. There is some evidence to suggest that in trout scales there is a minimum concentration of zinc above which there is a direct proportion between environmental and scale concentration. It is also possible that the response of trout to environmental zinc differs from that of salmon.

76-001176 Addison, R. F.; Zinck, M. E.; Leahy, J. r. METABOLISM OF SINGLE AND COMBINED DOSES OF ^{14}C -ALDRIN AND ^3H -p,p'-DDT BY ATLANTIC SALMON (/SALMO SALAR/) FRY. J. Fish. Res. Board Can. 33 (9): 2073-2076. Sept. 1976. In English with French summ. 21(3).

[Dep. Environ., Fish. Mar. Serv., Mar. Ecol. Lab., Bedford Inst. Oceanogr., Dartmouth, NS B2Y 4A2 Canada]

Atlantic salmon (/Salmo salar/) fry were injected intramuscularly with ^3H -p,p'-DDT and ^{14}C -aldrin either alone or as a mixture at concentrations similar to those found in "naturally" contaminated fish; their rates of metabolism and clearance were then compared. ^3H -p,p'-DDT was cleared slowly from the fish: approximately 60 percent of the injected material remained 8 wk after injection. ^{14}C -aldrin was cleared much more rapidly, only 55 percent of the injected material remaining in the fish 1 day after injection and less than 10 percent remaining at the end of the experiment. ^3H -p,p'-DDT was dehydrochlorinated to p,p'-DDE; assuming an exponential rate of conversion, its half-life was 60 days. In contrast, 50 percent of the aldrin residues in the fish were epoxidized to dieldrin within 2 days. No interactions between the insecticides were observed, although aldrin apparently induced a slight increase in the fraction of total body weight accounted for by liver.

76-001177 Adelman, I. R.; Smith, L. L., Jr. STANDARD TEST FISH DEVELOPMENT PART II, CHRONIC TOXICITY OF GUTHION TO THE FATHEAD MINNOW (/PIMEPHALES PROMELAS/ RAFINESQUE). U.S. Environ. Prot. Agency Natl. Environ. Res. Cent. Ecol. Res. Ser. EPA-600/3-76-061b. vii + 23p. July 1976. SFA 21(3).

[Dep. Entomol. Fish. Wildl., Univ. Minn., St. Paul 55108] Three chronic bioassays of Guthion were conducted with fathead minnows. All tests were begun with eggs and the longest lasted 20 days after termination of spawning, a total of 250 days. Parameters measured were survival, growth, fecundity, and growth and survival of second generation fry and eggs. The most sensitive criteria for effect of the toxicant was fecundity. The maximum acceptable toxicant concentration was between 0.33 and 0.51 $\mu\text{g/liter}$ Guthion, and the application factor was between .0017 and .0027 based on a soft water acute and a hard water chronic bioassay.

76-001178 Adelman, I. R.; Smith, L. L., Jr. STANDARD TEST FISH DEVELOPMENT PART I, FATHEAD MINNOWS (/PIMEPHALES PROMELAS/) AND GOLDFISH (/CARASSIUS AURATUS/) AS STANDARD FISH IN BIOASSAYS AND THEIR REACTION TO POTENTIAL REFERENCE TOXICANTS. U.S. Environ. Prot. Agency Natl. Environ. Res. Cent. Ecol. Res. Ser. EPA-600/3-76-061a. x + 77p. July 1976. SFA 21(3).

[Dep. Entomol. Fish. Wildl., Univ. Minn., St. Paul 55108] Fathead minnows and goldfish were compared for availability of LC_{50} 's with four toxicants as a means of determining their suitability as a standard bioassay fish. Acute bioassays with sodium chloride, pentachlorophenol, hexavalent chromium and Guthion were conducted with both species; and results were reported as toxicity curves as well as LC_{50} 's at various times. Both species showed similar variability of bioassay results. Bioassays of pentachlorophenol were conducted with both species to determine the effect of testing different sized fish of the same age or testing different aged fish. Size selection of fish within the ranges tested is unnecessary since differences in LC_{50} 's were small. Since age of fathead minnows did not affect the LC_{50} 's after 24 hours, use of younger fish would allow smaller bioassay chambers or more fish per chamber. Since goldfish could not be induced to complete a life cycle in the laboratory in less than one year, fathead minnows were superior as a standard species because of their smaller size and their utility in complete life cycle tests. On the

76-001178 CONTINUED

basis of seven criteria, sodium chloride was superior for use as a reference toxicant with pentachlorophenol a close second choice.

76-001179 Bills, T. D.; Marking, L. L. TOXICITY OF 3-TRIFLUOROMETHYL-4-NITROPHENOL (TFM), 2',5-DICHLORO-4'-NITROSALICYLANILIDE (BAYER 73), AND A 98:2 MIXTURE TO FINGERLINGS OF SEVEN FISH SPECIES AND TO EGGS AND FRY OF COHO SALMON. U.S. Fish Wildl. Serv., Invest. Fish Control No. 69. 9p. 1976. SFA 21(3).

[U.S. FWS, Fish Control Lab., La Crosse, WI 54601] We determined the toxicity of the lampricides 3-trifluoromethoxy-4-nitrophenol (TFM) and 2',5-dichloro-4'-nitrosalicylanilide (Bayer 73) and a 98:2 mixture of these compounds against fingerlings of seven species of fish--brown trout (*Salmo trutta*/), rainbow trout (*Salmo gairdneri*/), lake trout (*Salvelinus namaycush*/), brook trout (*Salvelinus fontinalis*/), channel catfish (*Ictalurus punctatus*/), bluegill (*Lepomis macrochirus*/), and yellow perch (*Perca flavescens*/)--and to eggs and fry of coho salmon (*Oncorhynchus kisutch*/). Channel catfish were the most sensitive to TFM and brown trout to Bayer 73. Bluegills were the most resistant to both TFM and Bayer 73. The toxicity of TFM and Bayer 73 individually was influenced far more by pH than was the mixture in standard laboratory tests with rainbow trout. Toxicity of the mixture was additive or less than additive to all species and life stages tested. The mixture was slightly more toxic to larval lampreys (*Petromyzon marinus*/) than to other fish in comparable laboratory toxicity tests. The margin of safety was narrow, however, when the 24-h toxicity for brown trout or rainbow trout was compared with the 24-h LC99 for sea lamprey larvae.

76-001180 Brenner, F. J.; Corbett, S.; Shertzer, R. EFFECT OF FERRIC HYDROXIDE SUSPENSION ON BLOOD CHEMISTRY IN THE COMMON SHINER, *NOTROPUS CORNUTUS*/. Trans. Am. Fish. Soc. 105 (3): 450-455. May 1976. SFA 21(3).

[Biol. Dep., Grove City Coll., Grove City, PA 16127] Common shiners, *Notropus cornutus*/, were exposed to 3 ppm ferric hydroxide for periods from two to eight weeks. Ferric hydroxide resulted in initial changes in serum protein, glucose, Na and K ions, but these changes did not adversely affect the internal dynamics of the fish.

76-001181 Brooks, R. R.; Lewis, J. R.; Reeves, R. D. MERCURY AND OTHER HEAVY METALS IN TROUT OF CENTRAL NORTH ISLAND, NEW ZEALAND. N. Z. J. Mar. Freshwater Res. 10 (2): 233-244. June 1976. SFA 21(3).

[Dep. Chem. Biochem. Biophys., Massey Univ., Palmerston North, New Zealand] Various organs of 111 specimens of rainbow trout *Salmo gairdneri*/ and 4 of brown trout *Salmo trutta*/ from various lakes and rivers in the central North Island were analysed for mercury, cadmium, copper, iron, manganese, and zinc. Except for mercury, none of the edible portions of any of the specimens had heavy metal concentrations likely to cause problems in public health. Mercury in the flesh of fish caught from Lakes Rotorua, Rotoiti, Rotomahana, and Maraetai averaged 1.3 ug g^{-1} and was well above the normally accepted maximum of 0.5 ug g^{-1} . The mercury levels in fish from Lake Maraetai (mean 1.40 ug g^{-1}) were assumed to have been derived in part from a pulp and paper mill at Kinkleith. High levels in other localities were presumed to be derived from adjacent geothermal areas. Acceptable daily consumptions of fish from various areas are recommended. In some areas (e.g. Lake Rotomahana), relatively small amounts (14 g of flesh) contain the acceptable daily intake of mercury, but because of lower mercury concentrations in smaller fish, the daily consumption can be increased if large fish are avoided.

76-001182 Brown, G. W., Jr. EFFECTS OF POLLUTION SUBSTANCES ON ENZYMES OF AQUATIC ORGANISMS. J. Fish. Res. Board Can. 33 (9): 2018-2022. Sept. 1976. In English with French summ. SFA 21(3).

[Coll. Fish., Univ. Wash., Seattle 98195] The toxicity of heavy metal cations often considered as pollutants is discussed with respect to several enzymes of nitrogen metabolism in the trout *Salmo gairdneri* and the polychaete *Eudistylia vancouveri*. Data on trout liver ornithine aminotransferase (EC 2.6.1.13) activity under inhibition by mercuric ion yield a straight line when percent inhibition on a probability axis is plotted vs. logarithm of mercuric ion concentration. Allantoinase (EC 3.5.2.5) of *E. vancouveri* is inhibited by divalent cations of Cu, Hg, Zn, Pb, and Cd. At low concentrations (approximately 10^{-8} M) these ions lead to an enhancement of activity of allantoinase. A short review is provided on the adaption of fish to environmental changes.

76-001183 Bulkley, R. V. CHEMICAL AND PHYSICAL EFFECTS ON THE CENTRARCHID BASSES. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 286-294. 1975. SFA 21(3).

[Iowa Coop. Fish. Res. Unit., Iowa State Univ., Ames 50010]

76-001184 Danil'chenko, O. P.; Stroganov, N. S. EVALUATION OF TOXICITY TO THE EARLY ONTOGENY OF FISHES OF SUBSTANCES DISCHARGED INTO A BODY OF WATER. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiolog.) 15 (2): 311-319. 1975. SFA 21(3).

[Water Toxicol. Lab., Moscow Univ., Moscow, USSR] The effect of a number of antiseptics on the embryonic and early postembryonic development of the following freshwater teleost fishes is investigated: the pike *Esox lucius*, the perch *Perca fluviatilis*, the ruffe *Acerina cernua*, the roach *Rutilus rutilus*, the minnow *Phoxinus phoxinus*, the gudgeon *Gobio gobio*, the loach *Misgurnus fossilis* and the spiny loach *Cobitis taenia*. The degree of toxicity of the substances is assessed from their influence on the early development of these fishes.

76-001185 Davis, J. C. PROGRESS IN SUBLETHAL EFFECT STUDIES WITH KRAFT PULPMILL EFFLUENT AND SALMONIDS. J. Fish. Res. Board Can. 33 (9): 2031-2035. Sept. 1976. In English with French summ. SFA 21(3).

[Dep. Environ., Fish. Mar. Serv., Pac. Environ. Inst., West Vancouver, BC V7V 1N6, Canada] Literature values of incipient sublethal response threshold concentrations for salmonids to effluent from neutralized whole bleached kraft mills, kraft bleaching, and the production of unbleached pulp for salmonids are summarized. Sublethal responses include effects on growth, behavior, energetics, metabolism, respiration, circulation, and temperature tolerance in a variety of salmonids. The average incipient threshold concentration for all species surveyed was 0.16 of the 96-h LC50 and ranged from 0.006 to 0.33 96-h LC50 for neutralized whole bleached kraft mill effluent. Large differences in sensitivity were not evident between salmonid species or the three effluent types surveyed. On the basis of this analysis, I suggest for neutralized whole bleached kraft mill effluent, that some sublethal effects will be present at a discharge dilution of 0.1 96-h LC50, few at 0.05 96-h LC50, and only rarely at 0.02 96-h LC50. However, at a dilution of 0.02 of the 96-h LC50, flesh tainting or color effects on the food chain may remain. These criteria are considered tentative and subject to revision with new knowledge and do not necessarily ensure protection of aquatic communities or sensitive food-chain organisms. Future research needs and suggestions

SPORT FISHERY ABSTRACTS

76-001185 CONTINUED

for criteria implementation are discussed.

76-001186 Delisle, C. E.; Allan, D. J. PLEXIGLAS CAGES FOR THE STUDY OF BIOLOGICAL EFFECTS OF INDUSTRIAL EFFLUENTS. Prog. Fish-Cult. 38 (2): 114-116. Apr. 1976. SFA 21(3).

[Ecol. Sect., Noranda Res. Cent., Pointe Claire, PQ H9R G5, Canada] For conducting in situ tests to examine the relative toxicities of various municipal and industrial effluents and compounds, we describe the construction and field use of Plexiglas cages of two sizes: 29 x 18 x 12 in. and 9.5 x 5 x 3.5 in. The larger cage, which is collapsible, is used to expose fish and large invertebrates to fresh and salt water conditions; the smaller cage is used to expose small invertebrates or small fish to the same conditions. The indicator species used in the tests appeared to adapt well to the cages and there were no mechanical or corrosion problems with the cages. Tests can be conducted in either lentic or lotic systems and in either fresh or salt water at any depth.

76-001187 Dunn, B. P.; Stich, H. F. MONITORING PROCEDURES FOR CHEMICAL CARCINOGENS IN COASTAL WATERS. J. Fish. Res. Board Can. 33 (9): 2040-2046. Sept. 1976. In English with French summ. 21(3).

[Cancer Res. Cent., Dep. Zool., Univ. British Columbia, Vancouver, BC, Canada] Sampling procedures and analytical techniques have been developed for evaluating the contamination of coastal waters by polycyclic aromatic hydrocarbon carcinogens. The procedures involve extraction and purification of hydrocarbon fractions from marine sediments or organisms, and determination of compounds by thin-layer chromatography and fluorimetry, or gas chromatography. Sediment samples in the vicinity of a sewage outfall showed elevated levels of benzo[a]pyrene (B[a]P). Mussels (*Mytilus edulis*) taken from the outer Vancouver harbor showed lower B[a]P levels in the summer than in the winter, perhaps a result of seasonal discharges of sewage and storm drain water into the harbor. Elevated levels of B[a]P in mussels growing near creosoted timbers or pilings suggested that creosote may be a significant source of B[a]P in the marine environment. Direct evidence for this suggestion was obtained by comparison of gas chromatographic profiles of polycyclic aromatic hydrocarbons isolated from mussels and from creosoted wood. The procedures developed are rapid, sensitive, and reproducible. They appear to be suitable for application in large-scale monitoring systems for carcinogenic hydrocarbons in coastal waters.

76-001188 Fava, J. A.; Tsai, C. IMMEDIATE BEHAVIORAL REACTIONS OF BLACKNOSE DACE, *RHINICHTHYS ATRATULUS*, TO DOMESTIC SEWAGE AND ITS TOXIC CONSTITUENTS. Trans. Am. Fish. Soc. 105 (3): 430-441. May 1976. SFA 21(3).

[Ichthyological Assoc., Inc., 100 S. Cass St., Middletown, DE 19709] Using a channelled avoidance trough, immediate behavioral reactions of blacknose dace to a domestic sewage effluent and its toxic constituents, chloramines, free chlorine, and ammonia, were investigated. Two avoidance indexes were computed from time spent and number of entries by the fish into a test solution channel and a clean water channel. The time avoidance index was found to be a more sensitive measurement than the entry avoidance index for fish behavioral reactions. On the basis of the time avoidance index, the fish did not avoid unchlorinated sewage effluent and ammonium chloride solution in concentrations as high as 270 mg/liter as ammonia-nitrogen. The fish did avoid chlorinated sewage effluent, chloramines, and free chlorine. The degree of fish avoidance increased as total chlorine concentration increased. The threshold avoidance

76-001188 CONTINUED

concentration under the test conditions was 0.13 mg/liter as total chlorine for chlorinated sewage effluent, 0.18 mg/liter for chloramines, and 0.61 mg/liter for free chlorine (DPD colorimetric method). The degree of fish avoidance and the pattern of behavioral responses to chlorinated sewage effluent were almost identical with those to chloramines, but different from those to free chlorine. The results suggest that chloramines are the major factor causing avoidance reaction of blacknose dace to chlorinated sewage effluent.

76-001189 Groderius, S. J.; Smith, L. L., Jr. EFFECT OF HYDROGEN SULFIDE ON FISH AND INVERTEBRATES PART II-HYDROGEN SULFIDE DETERMINATION AND RELATIONSHIP BETWEEN PH AND SULFIDE TOXICITY. U.S. Environ. Prot. Agency Natl. Environ. Res. Cent. Ecol. Res. Ser. EPA-600/3-76-062b. ix + 109p. July 1976. SFA 21(3).

[Dep. Entomol. Fish. Wildl., Univ. Minn., St. Paul 55108] An analytical method was developed for direct determination of ug/liter concentrations of molecular H(2)S. The procedure involves bubbling compressed nitrogen through an aqueous sulfide solution to displace H(2)S which is collected in a glass bead concentration column and measured colorimetrically. The H(2)S concentration is calculated from the determined sulfide displacement rate and by reference to a log linear standard curve relating temperature with the H(2)S displacement rate to the H(2)S concentration in standard solutions. The described analytical technique was used to define the relationship between test pH and sulfide toxicity to the fathead minnow.

76-001190 Hara, T. J.; Law, Y. M. C.; Macdonald, S. EFFECTS OF MERCURY AND COPPER ON THE OLFACTORY RESPONSE IN RAINBOW TROUT, /SALMO GAIARDNERI/. J. Fish. Res. Board Can. 33 (7): 1568-1573. July 1976. In English with French summ. SFA 21(3).

[Dep. Environ., Fish. Mar. Serv., Freshwater Inst., Winnipeg, MB R3T 2N6, Canada] The effects of mercury and copper on the olfactory response of rainbow trout (/Salmo gairdneri/) were studied by perfusing HgCl(2) and CuSO(4) solutions through the olfactory organs while recording the olfactory bulb electrical responses to the standard stimulant, L-serine. The olfactory response was depressed during exposure to mercury and copper. The lowest concentrations of mercury and copper needed to cause appreciable effects within 2 h were estimated at 0.10 and 0.008 mg/liter, respectively. The depression increased with increase in the concentration and exposure time of the heavy metals. Recovery of the olfactory response was slower with higher concentrations and longer exposure. The method is rapid, accurate, and sensitive, and can be applied to other toxic chemicals and fish species.

76-001191 Holcombe, G. W.; Benoit, D. A.; Leonard, E. N.; McKim, J. M. LONG-TERM EFFECTS OF LEAD EXPOSURE ON THREE GENERATIONS OF BROOK TROUT (/SALVELINUS FONTINALIS/). J. Fish. Res. Board Can. 33 (8): 1731-1741. Aug. 1976. In English with French summ. SFA 21(3).

[U.S. EPA, Environ. Res. Lab., Duluth, MN 55804] Exposure of three generations of brook trout (/Salvelinus fontinalis/) to mean total lead concentrations (0.9-474 ug/liter) showed that all second-generation trout exposed to 235 and 474 ug Pb/liter and 34 percent of those exposed to 119 ug Pb/liter developed severe spinal deformities (scoliosis). Scoliosis also appeared in 21 percent of the newly hatched third-generation alevins exposed to 119 ug Pb/liter, and weights of these fish 12 wk after hatch were significantly reduced. Gill, liver, and kidney tissues of first- and second-generation brook trout accumulated the greatest amount of lead. Only small amounts accumulated in the edible muscle. An equilibrium of lead residues was

76-001191 CONTINUED

reached in liver and kidney tissue from second-generation fish after 70 wk of exposure, but not in gill tissue. Fish exposed to 119 ug Pb/liter and then placed in uncontaminated control water for 12 wk showed a 70, 78, and 74 percent loss in micrograms Pb per gram for gill, liver, and kidney tissue, respectively, and a 39, 56, and 35 percent loss, respectively, in the total micrograms of Pb in the whole tissue. Residue analysis of eggs, alevins, and juveniles showed that lead was accumulated during these life stages. The maximum acceptable toxicant concentration (MATC) for brook trout in water with a hardness of 44 mg/liter (as CaCO₃) and a pH of 6.8-7.6 lies between 58 and 119 ug/liter for total lead and between 39 and 84 ug/liter for dissolved lead. The 96-h LC50 for brook trout was 4100 ug/liter based on total lead and 3362 ug/liter based on dissolved lead; therefore, the application factor (MATC/96-h LC50) lies between 0.012 and 0.029 for both total and dissolved lead. --From abstr.

76-001192 Kleerekoper, H. EFFECTS OF SUBLETHAL CONCENTRATIONS OF POLLUTANTS ON THE BEHAVIOR OF FISH. J. Fish. Res. Board Can. 33 (9): 2036-2039. Sept. 1976. In English with French summ. SFA 21(3).

[Dep. Biol., Texas A&M Univ., College Station, TX 77843] Due to dilution and dispersion of pollutants in the natural environment, chronic exposure to subacute concentrations of such substances is likely to affect a much larger number of species and individuals than exposure to acutely morbid or lethal concentrations. Evidence points to the behavioral toxicity of subacute concentrations of pesticides affecting general locomotor behavior and orientated responses to environmental variables in particular. Complex interaction of these variables also may occur and the response to such interaction by fish may be affected by chronic exposure to organophosphate. Response modifications are often subtle and may require long-term monitoring.

76-001193 Korn, S.; Hirsch, N.; Struhsaker, J. W. UPTAKE, DISTRIBUTION, AND DEPURATION OF ¹⁴C-BENZENE IN NORTHERN ANCHOVY, /ENGRAULIS MORDAX/, AND STRIPED BASS, /MORONE SAXATILIS/. NOAA Fish. Bull. 74 (3): 545-551. July 1976. SFA 21(3).

[NMFS, Northwest Fish. Cent., P.O. Box 155, Auke Bay, AK 99821] The uptake, distribution, and depuration of water-soluble, monocyclic hydrocarbon contained in petroleum and refined products was studied in two species of marine fish. Mature northern anchovy, /Engraulis mordax/, and juvenile striped bass, /Morone saxatilis/, were exposed to sublethal concentrations of ¹⁴C-benzene for 48 h. Residues in tissues exhibiting a high lipid content or representing apparent major metabolic sites were measured during the exposure and afterwards when the fish were transferred to clean seawater. Fish exhibited a rapid uptake over a wide range of benzene concentrations in the water column. Accumulation in anchovy was considerably greater than in striped bass. Results indicate that the pathway of hydrocarbons through the liver, gallbladder, intestines, and colon is a major depuration route. Residues were depurated rapidly after cessation of exposure; in striped bass tissues most residues were undetectable by 7 days.

76-001194 Lewis, M. EFFECTS OF LOW CONCENTRATIONS OF MANGANOUS SULFATE ON EGGS AND FRY OF RAINBOW TROUT. *Frog. Fish-Cult.* 38 (2): 63-65. Apr. 1976. SFA 21(3).

[Dep. Zool., Ariz. State Univ., Tempe 85281] Eggs and fry of rainbow trout (*Salmo gairdneri*) were held in water with manganous sulfate concentrations of 1, 5, and 10 mg/l, which are representative of levels commonly found in Pennsylvania streams. Egg mortality ranged from 5 to 23 percent for the 29-day incubation period; times of eyeing and hatching were not affected. Manganous sulfate at these concentrations was not toxic to fry in short-term tests (72 h), nor did 4-wk-old fry show a significant avoidance response to the chemical.

76-001195 Lorz, H. W.; McPherson, B. P. EFFECTS OF COPPER OR ZINC IN FRESH WATER ON THE ADAPTATION TO SEA WATER AND ATPASE ACTIVITY, AND THE EFFECTS OF COPPER ON MIGRATORY DISPOSITION OF COHO SALMON (*ONCORHYNCHUS KISUTCH*). *J. Fish. Res. Board Can.* 33 (9): 2023-2030. Sept. 1976. In English with French summ. SFA 21(3).

[Oreg. Dep. Fish Wildl., Res. Sect., Corvallis 97331] The 96-h LC50 of copper (CuCl_2) for yearling coho salmon (*Oncorhynchus kisutch*) was found to decrease from 74 ug/liter Cu in November to 60 ug/liter in May as the fish became smolts. The 96-h LC50 of zinc (ZnCl_2) for yearling coho in April was 4600 ug/liter Zn. All tests were conducted at 10-12 C in water with alkalinity and hardness ranging from 68 to 78 and 89 to 99 mg/liter as CaCO_3 , respectively. Exposures of yearling coho for 144 h to sublethal concentration of zinc in fresh water had little effect on the enzyme activity of Na^+ , K^+ -activated ATPase in gill microsomes or on the survival of fish transferred to sea water. Acute and chronic exposures (maximum of 4128 h) of yearling coho salmon to sublethal concentrations of copper (5-30 ug/liter) in fresh water had deleterious effects on downstream migration after the fish were placed in a natural stream, gill ATPase activity, and survival in sea water. More severe effects were produced in the chronic exposures than in 144-h exposures on downstream migration and survival in sea water, but not on gill ATPase. Effects of copper began to occur within 24-72 h and were often maximized within 120-144 h of exposure. Concentrations of copper (5-20 ug/liter) were 0.09-0.35 of the 96-h LC50 for coho smolts.

76-001196 Parrish, P. R.; Cook, G. H.; Patrick, J. M., Jr. HEXACHLOROBENZENE: EFFECTS ON SEVERAL ESTUARINE ANIMALS. *Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm.* 28: 179-187. 1975. SFA 21(3).

[Bionomics-EG &G, Inc., Rt. 6, Box 1002, Pensacola, FL 32507] Tests were conducted to determine (1) the acute (96-hour) toxicity of hexachlorobenzene (HCB) to pink shrimp (*Penaeus duorarum*), grass shrimp (*Palaemonetes pugio*), sheepshead minnows (*Cyprinodon variegatus*) and pinfish (*Lagodon rhomboides*) and (2) the rate of HCB uptake and depuration by pinfish. Hexachlorobenzene was not acutely toxic to any of the animals tested at measured concentrations in sea water to 25 ug/l. However, both species of shrimps in the highest HCB concentration were lethargic as compared to controls and exhibited an uncharacteristically white hepatopancreas at the end of the 96-hour exposure. Pinfish exposed to average measured HCB concentrations of 0.06, 0.15, 0.65, 1.87, or 5.2 ug/l for 42 days accumulated the compound throughout the exposure. Maximum residue in muscle (wet-weight) was 34,000X the measured concentration in test water. Pinfish retained most (greater than 50 percent) of the HCB after a 28-day depuration period in HCB-free water.

76-001197 Pentreath, R. J. SOME FURTHER STUDIES ON THE ACCUMULATION AND RETENTION OF ^{65}Zn AND ^{54}Mn BY THE PLAICE, *PLEURONECTES PLATESSA* L. J. Exp. Mar. Biol. Ecol. 21 (2): 179-189. Feb. 1976. SFA 21(3).

[Minist. Agric. Fish. Food, Fish. Radiobiol. Lab., Lowestoft, Suffolk, England] Some further studies on the accumulation and retention of ^{65}Zn and ^{54}Mn by plaice, *Pleuronectes platessa* L., have been made. Direct accumulation from water, by eggs and larvae, is insufficient to account for the concentrations of these metals in young fish. It appears, therefore, that, from the earliest stages, food constitutes the major pathway for accumulation. Stable element analyses of liver, muscle, and bone samples from fish of differing weights and ages show that their concentrations, in adult fish, remain fairly constant. On this basis it has previously been estimated that biological half-times of these metals /via/ food should be shorter than those observed after accumulation from labelled water. Experiments following the loss of the isotopes from fish which had been fed labelled polychaete worms support this view.

76-001198 Peterson, R. H. TEMPERATURE SELECTION OF JUVENILE ATLANTIC SALMON (*SALMO SALAR*) AS INFLUENCED BY VARIOUS TOXIC SUBSTANCES. J. Fish. Res. Board Can. 33 (8): 1722-1730. Aug. 1976. In English with French summ. SFA 21(3).

[Dep. Environ., Fish. Mar. Serv., Biol. Stn., St. Andrews, NB EOG 2X0, Canada] Previous exposure to sodium pentachlorophenate (NaPCP), Guthion, malathion, Dursban, and Dibrom lowered the preferred temperature for juvenile Atlantic salmon (*Salmo salar*) tested in a horizontal temperature gradient. Lindane, CuSC(4), ZnSO(4), CdSO(4), Sevin, heptachlor, and fenitrothion did not change the preferred temperature significantly. Comparison with other published results indicates that those substances that increase the preferred temperature are more toxic (based on relevant changes in 24-h LC50) at low temperatures and vice versa. It is suggested that such shifts in selected temperature may be of potential immediate, short-term, survival value to the fish.

76-001199 Rosenberg, D. M.; Wiens, A. P. COMMUNITY AND SPECIES RESPONSES OF CHIRONOMIDAE (DIPTERA) TO CONTAMINATION OF FRESH WATERS BY CRUDE OIL AND PETROLEUM PRODUCTS, WITH SPECIAL REFERENCE TO THE TRAIL RIVER, NORTHWEST TERRITORIES. J. Fish. Res. Board Can. 33 (9): 1955-1963. Sept. 1976. In English with French summ. SFA 21(3).

[Dep. Environ., Fish. Mar. Serv., Freshwater Inst., Winnipeg, MB R3T 2N6, Canada] On oiled and unoiled artificial substrates in the Trail River, Northwest Territories, communities of Chironomidae were different during open-water periods but were similar over the winter. Greater numbers of species and individuals of Orthocladiinae occurred on the oiled than on the unoiled artificial substrates. The reverse was true for Tanyptodinae and Chironominae. Ten species of Chironomidae showed a positive response to the presence of oil, 9 species showed a negative response, and 10 species were apparently unaffected. Based on the results of this study and a literature review, 11 species of Chironomidae showing either positive or negative responses to contamination by oil or petroleum products were evaluated for their potential to indicate oil contamination of freshwater ecosystems. Three criteria were used: taxonomic soundness, wide zoogeographic distribution, and numbers in the community. We predict that *Nilotanyptus fimbriatus* (Walk.), *Cricotopus bicinctus* (Meig.), and *C. varipes* Cqg., individually or as an assemblage, would fulfill this role.

76-001200 Rosenthal, H.; Alderdice, D. F. SUBLETHAL EFFECTS OF ENVIRONMENTAL STRESSORS, NATURAL AND POLLUTIONAL, ON MARINE FISH EGGS AND LARVAE. J. Fish. Res. Board Can. 33 (9): 2047-2065. Sept. 1976. In English with French summ. 21(3).

[Biol. Anst. Helgoland, 2 Hamburg 50, Federal Republic of Germany] Sublethal effects of environmental changes on marine fish eggs and larvae are reviewed within a framework of concepts supplied by Bartholomew (1964), Sprague (1971), and Selye (1952). Such effects are those a) elicited through application of stress at one level of organization or development, b) recognized through the appearance of altered structure or function at a later stage of development, and c) whose significance is fully manifested as lower survival potential at a further stage of development. A number of sublethal effects are marshalled in terms of type of biological response and inferred consequences. Data suggest that a variety of stress-stressor systems may trigger a limited number of organismic responses, often appearing to involve the same physiological and biochemical mechanisms. Most sublethal effects appear to be biochemical in origin, elicited through physical or chemical change, and expressed in terms of histological, morphological, physiological, or ethological response. A need is expressed for an expanded and more unified enquiry into the origin, recognition, and significance of sublethal effects.

76-001201 Sarot, D. A.; Perlmutter, A. THE TOXICITY OF ZINC TO THE IMMUNE RESPONSE OF THE ZEBRAFISH, *BRACHYDANIO RERIO*, INJECTED WITH VIRAL AND BACTERIAL ANTIGENS. Trans. Am. Fish. Soc. 105 (3): 456-459. May 1976. SFA 21(3).

[Lab. Aquatic Biol., N. Y. Univ., Washington Square 10003] Groups of zebrafish, *Brachydanio rerio*, were injected with antigens prepared from infections pancreatic necrosis virus (IPNV) or *Proteus vulgaris*. Zinc appeared to suppress the immune response against *Proteus vulgaris*, but not against IPNV.

76-001202 Schimmel, S. C.; Parrish, P. R.; Hansen, D. J.; Patrick, J. M., Jr.; Forester, J. ENDRIN: EFFECTS ON SEVERAL ESTUARINE ORGANISMS. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 187-194. 1975. SFA 21(3).

[U.S. EPA, Gulf Breeze Environ. Res. Lab., Sabine Island, Gulf Breeze, FL 32561] Acute (96-hour) bioassays were performed with endrin and the following estuarine organisms: American oyster (*Crassostrea virginica*), pink shrimp (*Penaeus duorarum*), grass shrimp (*Palaemonetes pugio*), sailfin molly (*Poecilia latipinna*) and sheepshead minnow (*Cyprinodon variegatus*). Endrin was acutely toxic to all organisms tested, except oysters, whose shell growth was appreciably inhibited by 56 ug/l (parts per billion) of the chemical. Pink shrimp were the most sensitive animal tested, but significant numbers of both species of shrimps and fishes died when exposed to concentrations of one ug/l or less. In a separate test, embryos and fry of the sheepshead minnow were exposed to concentrations of endrin ranging from 0.046 to 1.0 ug/l (nominal) for 33 days in an intermittent-flow bioassay. Embryos were not affected by the concentrations to which they were exposed, but the estimated LC50 (probit analysis, $\alpha=0.05$) of fry was 0.27 ug/l.

76-001203 Schimmel, S. C.; Hansen, D. J. SHEEPSHEAD MINNOW (/CYPRINODON VARIEGATUS/): AN ESTUARINE FISH SUITABLE FOR CHRONIC (ENTIRE LIFE-CYCLE) BIOASSAYS. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 392-398. 1975. SFA 21(3).

[U.S. EPA, Gulf Breeze Environ. Res. Lab., Sabine Island, Gulf Breeze, FL 32561] The sheepshead minnow (/Cyprinodon variegatus/), an estuarine fish of the Atlantic and Gulf Coasts, is suitable for both partial chronic and chronic (egg-to-egg) bioassays. The fish is easily held at high population densities in the laboratory and, at about 30 C, produces numerous eggs. The average 30-day survival of the fish from fertile egg to fry is 75 percent. Generation time for this species is short (3-4 months) and its small adult size (male average standard length = 48 mm) provides for relatively inexpensive bioassays. This killifish's susceptibility to organochlorine toxicants is similar to that of other estuarine fishes tested and thus should produce significant information on the effects of these toxicants on the estuarine community.

76-001204 Smith, L. L., Jr.; Oseid, D. M.; Adelman, I. R.; Broderius, S. J. EFFECT OF HYDROGEN SULFIDE ON FISH AND INVERTEBRATES PART I-ACUTE AND CHRONIC TOXICITY STUDIES. U.S. Environ. Prot. Agency Natl. Environ. Res. Cent. Ecol. Res. Ser. EPA-600/3-76-062a. xvi + 286p. July 1976. SFA 21(3).

[Dep. Entomol. Fish. Wildl., Univ. Minn., St. Paul 55108] Acute and chronic toxicity of hydrogen sulfide to seven fish species and eight invertebrates were determined in continuous-flow bioassays. In 159 acute tests lethal threshold concentration for juvenile fish varied from 0.0087 mg/liter in rainbow trout to 0.0840 mg/liter in goldfish. Except in goldfish, fry stage was up to three times more sensitive than the juvenile. In 96 tests on invertebrates the 96-hr LC50 ranged from 0.020 mg/liter in /Baetis/ to 1.070 mg/liter in /Asellus/. Acute toxicity of H(2)S to fathead minnows varied 24-fold between 6.5 and 24.0 C. Temperature effects were not as marked on invertebrates. In chronic exposure to H(2)S in 29 tests running up to 825 days, maximum no-effect concentration to fish ranged from 0.0004 mg/liter in bluegills to 0.0100 mg/liter in goldfish. In nine chronic tests running up to 138 days, maximum safe levels ranged from 0.0012 mg/liter in /Gammarus/ to 0.0152 mg/liter in /Hexagenia/. Application factors relating acute toxic (96-hr LC50 for juveniles) to no-effect levels varied from .231 in rainbow trout to .013 in bluegills and from .091 in /Gammarus/ to .048 in /Procambarus/.

76-001205 Smith, L. L., Jr.; Oseid, D. M.; Kimball, G. L.; El-Kandelgy, S. M. TOXICITY OF HYDROGEN SULFIDE TO VARIOUS LIFE HISTORY STAGES OF BLUEGILL (/LEPOMIS MACROCHIRUS/). Trans. Am. Fish. Soc. 105 (3): 422-449. May 1976. SFA 21(3).

[Dep. Entomol. Fish. Wildl., Univ. Minn., St. Paul 55108] Bluegill (/Lepomis macrochirus/ Rafinesque) eggs, fry, juveniles, and adults were exposed to H(2)S concentrations to determine acute toxicity. Seventy-two-hour LC(50) for eggs was 0.0190 mg/liter; 96-h LC(50) for 35-day-old fry was 0.0131 mg/liter, for juveniles 0.0478 mg/liter, and for adults 0.0448 mg/liter. Exposure to lower levels of H(2)S resulted in some acclimation. Chronic exposure to sublethal levels of H(2)S for up to 826 days resulted in no egg deposition at 0.022 mg/liter and reduced deposition after 97 days at 0.0010 mg/liter. Growth was adversely affected at levels from 0.0031 to 0.0107 mg/liter H(2)S depending on the life history stage at which chronic exposure was started. When exposure was started with eggs, the lower level retarded growth. Food consumption was reduced at 0.0085 mg/liter H(2)S. Time to anesthesia with MS:222 was reduced at levels from 0.0014 to 0.0031 mg/liter H(2)S. The most sensitive stage to acute toxicity was the

35-day-old CCNTINUED

feeding fry and to chronic toxicity was the spawning adult.

76-001206 Spehar, R. L. CADMIUM AND ZINC TOXICITY TO FLAGFISH, /JORDANELLA FLORIDAE. J. Fish. Res. Board Can. 33 (9): 1939-1945. Sept. 1976. In English with French summ. SFA 21(3).

[U.S. EPA, Environ. Res. Lab., Duluth, MN 55804] Cadmium and zinc toxicity to flagfish, (/Jordanelia floridae/) was determined on the basis of 96-h median lethal concentrations (LC50) and significant decreases ($P = 0.05$) in survival, growth, and reproduction over the complete life cycle of the fish. The 96-h LC50 values for cadmium and zinc to juvenile flagfish were 2500 and 1500 ug/liter, respectively. In chronic tests, reproduction was the most sensitive indicator of cadmium toxicity and was inhibited at 8.1 ug/liter. Tissue concentration analysis showed that fish exposed to concentrations of 1.7 ug/liter and above accumulated significantly greater amounts of cadmium than those in the controls. In zinc tests, survival of larvae (not exposed as embryos) and growth of females were the most sensitive measure of zinc toxicity and were reduced at respective concentrations of 85 and 51 ug/liter. Significant uptake of zinc occurred in fish exposed to concentrations of 47 ug/liter and above. The lowest cadmium and zinc concentrations causing adverse effects to the flagfish were similar to those affecting other fish species. Application factors for both metals were similar to those reported for cadmium exposed bluegills (/Lepomis macrochirus/) and zinc exposed fathead minnows (/Pimephales promelas/) in hard water.

76-001207 Sprague, J. B. CURRENT STATUS OF SUBLETHAL TESTS OF POLLUTANTS ON AQUATIC ORGNAISMS. J. Fish. Res. Board Can. 33 (9): 1988-1992. Sept. 1976. In English with French summ. SFA 21(3).

[Dep. Zool., Univ. Guelph, Guelph, ON, Canada] In the U.S. government's book /Water Quality Criteria, 1972/, 75 recommendations for "safe" levels of toxic pollutants were found in the sections on freshwater and marine aquatic life. Ten recommendations gave no specific numerical value, 20 seemed arbitrary, and a further 10 were essentially lethal concentrations. Thus, 40 of the 75 recommendations are somewhat unsatisfactory, mostly because adequate scientific basis is not yet available. For the other 35 recommendations based on sublethal or chronic effects, most (13) were derived from tests on reproduction and young stages of aquatic organisms. All other categories of physiological tests yielded only 10 criteria. Tissue residues were the basis for 7 recommendations but some were arbitrarily derived from tolerance levels in human food. Field observations gave rise to 5 criteria. Experiments on reproduction of organisms seem the most productive for useful results. Such tests with small tropical fish would be much more economical than those with longer-cycle fish native to the north. /Daphnia/ and algae yield high proportions of useful data and are even faster. Investigations of blood parameters, enzyme systems, etc., are more suitable for unravelling mechanisms of effect, but significance of pollutant effects is best determined at higher levels of integration. Responses such as avoidance may have been understudied, and may be more sensitive for some pollutants. Field experiments should receive more emphasis, as a final test of laboratory predictions. Studies of tissue residues should include biological effects, if any, not merely measurements of levels present.

76-001208 Statcham, C. N.; Melancon, M. J., Jr.; Lech, J. J. BIOCONCENTRATION OF XENOBIOTICS IN TROUT BILE: A PROPOSED MONITORING AID FOR SOME WATERBORNE CHEMICALS. Science 193 (4254): 680-681. Aug. 1976. SFA 21(3).

[J. J. Lech: Dep. Pharmacol., Med. Coll. Wis., Milwaukee 53233] A technique is proposed for the monitoring of certain xenobiotic pollutants in suspect aquatic environments by fish bile analysis. Bile removed from rainbow trout (*Salmo gairdneri*) exposed to nine different radioactive compounds in vivo contained concentrations of radioactivity greater than those in the surrounding water. Bile-to-water radioactivity ratios as high as 10,000 : 1 were found after 24-hour exposures. The results of these experiments suggest that analysis of bile of wild or caged fish from a suspect site may be useful as a qualitative monitoring aid for certain types of xenobiotics in water.

76-001209 Winner, R. W.; Farrell, M. P. ACUTE AND CHRONIC TOXICITY OF COPPER TO FOUR SPECIES OF *DAPHNIA*. J. Fish. Res. Board Can. 33 (8): 1685-1691. Aug. 1976. SFA 21(3).

[Dep. Zool., Miami Univ., Oxford, OH 45056] The sensitivity of *Daphnia magna*, *D. pulex*, *D. parvula*, and *D. ambigua* to acute and chronic copper stresses was evaluated under laboratory conditions. Using 72-h LC50 values as the index, the two larger species were significantly less sensitive to an acute copper stress than were the two smaller species. All four species exhibited reductions in survival at Cu concentrations greater than 40 ug/liter. *Daphnia magna* exhibited a decrease in the instantaneous rate of population growth (*r*) at Cu concentrations greater than 60 ug/liter; *r* decreased in the other three species at concentrations greater than 40 ug/liter. *Daphnia ambigua* produced significantly smaller broods at Cu concentrations greater than 40 ug/liter, whereas mean brood size did not decrease in *D. pulex* and *D. parvula* until the Cu concentration exceeded 60 ug/liter. *Daphnia magna* did not exhibit any reduction in mean brood size related to copper concentration; reproduction in this latter species was inhibited only as a consequence of females dying before they reached reproductive maturity at concentrations greater than 80 ug/liter. Application factors, based on the highest concentration that did not reduce survival and 72-h LC50 values, ranged from 0.47 to 0.59 and were not significantly different for the four species. We concluded that the four species do not differ in their susceptibility to a chronic copper stress.

76-001210 Woodward, D. F. TOXICITY OF THE HERBICIDES DINOSEB AND PICLORAM TO CUTTHROAT (*SALMO CLARKI*) AND LAKE TROUT (*SALVELINUS NAMAYCUSH*). J. Fish. Res. Board Can. 33 (8): 1671-1676. Aug. 1976. In English with French summ. SFA 21(3).

[U.S. FWS, Fish-Pesticide Res. Lab., Jackson, WY] In static tests of the toxicity of two herbicides, dinoseb (2,4-dinitro-6-sec-butylphenol) and picloram (4-amino-3,5,6-trichloropicolinic acid), to cutthroat (*Salmo clarki*) and lake trout (*Salvelinus namaycush*), the 96-h LC50s ranged from 32 to 1400 ug/liter for dinoseb and from 2050 to 8600 ug/liter for picloram. Decreasing pH from 8.5 to 6.5 increased the toxicity of dinoseb by a factor of 43 and decreased that of picloram by a factor of 0.5. Generally, toxicity increased with increasing water temperature. Sensitivity of both species of fish increased with water hardness in tests of dinoseb but was not affected by water hardness in tests of picloram. The toxicity of both chemicals was not changed by aging in water for up to 4 wk or by exposing the fish longer than 96 h. Rate of yolk sac absorption and growth of lake trout fry was reduced in flow-through tests at concentrations as low as 0.5 ug/liter dinoseb or 35 ug/liter picloram. Chronic toxicity of both compounds on early life stages of lake trout is more significant

76-001210 CONTINUED

than might be anticipated on the basis of only acute tests with fingerlings.

FISH TOXICANTS

76-001211 Buckner, J. L.; Perkins, C. J. THANITE: A FISH MANAGEMENT TOOL IN SOUTHLANDS EXPERIMENT FOREST PONDS. Proc. Annu. Conf. Southeast. Asscc. Game Fish Comm. 28: 123-126. 1975. SFA 21(3).

[International Paper Co., Southlands Exp. Forest, Bainbridge, GA] Thanite (82 percent isobornyl thiocynoacetate) has been used as a fish management tool on International Paper Company's Southlands Experiment Forest since 1968. Annually, Experiment Forest personnel successfully move 2,000 to 4,000 largemouth bass (*Micropterus salmoides*) with an 0.8 to 1 ppm (active ingredient) mixture of 80 percent Thanite-20 percent Atlox 1045-A. Collection and survival percentages are higher when water temperatures are less than 70 degrees F. Collected fish are placed in cans of untreated water in collection boats and later transferred to an aerated holding tank. Recovery in the tank is usually rapid and survival exceeds 90 percent.

76-001212 Engstrom-Heg, R. POTASSIUM PERMANGANATE DEMAND OF A STREAM BOTTOM. N. Y. Fish Game J. 23 (2): 155-159. July 1976. SFA 21(3).

[N. Y. State Dep. Environ. Conserv. Albany 12201] During rotenone treatment of a deep-outlet reservoir, the largely organic bottom of the outlet stream exerted a potassium permanganate demand independent of that of the outlet water. This demand reached a maximum when the water was heavily loaded with detritus from decaying fish and returned to approximately its original value after the onset of the fall overturn. When rotenone detoxification with potassium permanganate is planned for any stream or pond outlet having a mud or silt bottom, it is recommended that an in situ measurement of the total potassium permanganate demand be made. Techniques for making this measurement are described.

76-001213 Maki, A. W.; Johnson, H. E. THE FRESHWATER MUSSEL (*ANODONTA* SP.) AS AN INDICATOR OF ENVIRONMENTAL LEVELS OF 3-TRIFLUOROMETHYL-4-NITROPHENOL (TFM). U.S. Fish Wildl. Serv., Invest. Fish Control No. 70. 5p. 1976. SFA 21(3).

[Environ. Water Qual. Res. Dep., Procter & Gamble Co., Ivorydale Tech. Cent., Cincinnati, OH 45217] After freshwater mussels (*Anodonta* sp.) were exposed to 8.68-mg/l solutions of 3-trifluoromethyl-4-nitrophenol (TFM; ¹⁴C-TFM and analytical grade TFM) in a model stream for 24 h, uptake and elimination rates of TFM residues for three body components were determined by radioassay. The average residue concentrations (ugTFM/g wet wt) after the 24-h exposure were 44.4 in the foot, 37.7 in the gill, and 38.5 in the viscera. The average calculated half-time for residue elimination from the three components was 20.2 h. The rate of uptake and ultimate residue concentration was widely variable, presumably because the feeding and locomotor activity of individual mussels varied greatly during the exposure period.

RESEARCH AND MANAGEMENT-GENERAL

76-001214 Anderson, R. O. FACTORS INFLUENCING THE QUALITY OF LARGEMOUTH BASS FISHING. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 183-194. 1975. SFA 21(3).

[Mo. Coop. Fish. Res. Unit., Univ. Mo., Columbia 65201]

76-001215 Clark, R. D., Jr.; Lackey, R. T. MANAGING TRENDS IN ANGLER CONSUMPTION IN FRESHWATER RECREATIONAL FISHERIES. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 367-377. 1975. SFA 21(3).

[Dep. Fish. Wildl. Sci., VPI & SU, Blacksburg, VA 24061] A basic activity of freshwater recreational fisheries management agencies is forecasting societal demand for fisheries resources and producing the necessary supply. Today, potential consumption often exceeds the supply of fisheries of the desired quality. A primary means for enhancing contemporary fisheries management may be to regulate angler consumption. Operations research techniques are well suited for handling the complexities involved with planning multiple action policies for regulating angler consumption. PISCES is a computer simulator of the recreational fisheries management system of Tennessee, but is adaptable for use in any state. The purpose of PISCES is to aid in planning fisheries management decision policies at the macro level. PISCES generates predictions of how fisheries management agency activities will affect angler consumption for a fiscal year. Subjective probability distributions for random variables and Monte Carlo simulation techniques are employed in PISCES to produce an expected value and standard deviation for each prediction. Test runs under realistic hypothetical situations and discussions with personnel of the Tennessee Wildlife Resources Agency suggest that PISCES may help fisheries management agencies to improve budget allocation decisions, to formulate multiple action policies for regulating angler consumption, and to optimize fisheries development.

76-001216 Clepper, H. (ed.) BLACK BASS BIOLOGY AND MANAGEMENT. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. ix + 534p. 1975. SFA 21(3).

[Am. Forest. Assoc., 1319 18th St., N.W., Washington, DC 20036]

76-001217 Cross, G. H.; Groves, D. L. THE IMPACT OF THE "ENVIRONMENTAL MOVEMENT" UPON HUNTING AND FISHING. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 776-786. 1975. SFA 21(3).

[Dep. Fish. Wildl. Sci., VPI & SU, Blacksburg, VA 24061] Data available in the four national surveys of fishing and hunting (1955, 1960, 1965, 1970) were used to identify how participation in fishing and hunting has changed during the recent environmental movement. Participation in fishing has increased in nearly all segments of the population while participation in hunting has remained the same or may have decreased slightly. Participation in small game hunting decreased while participation in big game and waterfowl hunting increased. A decrease in participation in hunting was most notable in rural areas among farmers and farm laborers. The data in the national surveys did not indicate that an increased environmental awareness has influenced participation in fishing or hunting any substantial degree.

SPORT FISHERY ABSTRACTS

76-001218 Holbrook, J. A. II BASS FISHING TCURNAMENTS. IN H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 408-415. 1975. SFA 21(3).
[TVA, Norris, TN]

76-001219 Jensen, A. C. OFFSHORE OIL AND FISHERY RESCURCES. N. Y. Fish Game J. 23 (2): 138-148. July 1976. SFA 21(3).

[N. Y. State Dep. Environ. Conserv., Albany 12201] The prospect of petroleum reserves off New York and adjacent states has focused a detailed look at the living marine resources of the area as they might be affected by drilling for the petroleum and by possible cil spills. This paper reviews the offshore and coastal fishery resources in relation to the suspected petroleum reserves.

76-001220 Lackey, R. T.; Powers, J. E.; Zuboy, J. R. MODELING TO IMPROVE MANAGEMENT OF BASS FISHERIES. IN H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 430-435. 1975. SFA 21(3).

[Dep. Fish. Wildl. Sci., VPI & SU, Blacksburg, VA 24061]

76-001221 Loftus, K. H. SCIENCE FOR CANADA'S FISHERIES REHABILITATION NZEDS. J. Fish. Res. Board Can. 33 (8): 1822-1857. Aug. 1976. In English with French summ. SFA 21(3).

[Ontario Minist. Nat. Resour., Fish. Br., Toronto, ON Canada] A brief, generalized review of the current status of salmonid fisheries on the west and east coasts, and of selected representative waters in the freshwater area is presented. It is concluded that many fish communities and/or fish stocks are depressed, collapsed, or extinct as a result of severe stresses imposed directly, or indirectly, by man's activities. Rehabilitation of fish stocks and fish communities to levels approximating those of early years, and to levels capable of supporting more stable yields to meet growing client requirements appears practical. The need for explicit policy decisions with regard to sea ranching and rehabilitation as options for approaches to increasing fish abundance is stressed. Rehabilitation of stocks and communities will require additional science in areas such as hatching, rearing and selective breeding, fisheries engineering, and in the more precise definition of natural productive capacity of waters. Effective fisheries rehabilitation programs, and fisheries management generally, require: development of fisheries information systems; an adaptive or experimental approach; more social and economic data; synthesis and communication of science available; and fundamental reconsideration of the traditional institutional arrangements for fisheries wrk. Some important fisheries rehabilitation programs, carefully planned and assessed, can proceed immediately with confidence in their success; others must await improvement in water quality.

76-001222 Seidensticker, E. F. TEXAS BASS CLUBS. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 96-103. 1975. SFA 21(3).

[Texas Parks Wildl. Comm., Austin 78701] A 1972 survey was taken of Texas bass clubs to determine the number and location of organizations, their membership, club objectives, tournament regulations, fishing success and estimated harvest of bass from Texas reservoirs. Questionnaires were sent to 206 clubs, and reports were received from 170 of the groups during this study. The 170 reporting organizations collectively held 1,755 tournaments in 1972. Harvest records revealed an average catch per unit effort of 0.17 bass and/or 0.28 lb. per man-hour. Harvest from tournament lakes was, in most cases, less than 0.50 lb. per acre and was not considered harmful to

76-001222 CONTINUED
bass populations at this time.

76-001223 Stevens, R. E. CURRENT AND FUTURE CONSIDERATIONS CONCERNING STRIPED BASS CULTURE AND MANAGEMENT. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 69-73. 1975. SFA 21(3).

[Marine Protein Corp., Miami, FL] One million acres of water in inland reservoirs currently contain fishable populations of striped bass. Fingerling production in 1974 was in excess of 10.5 million fish and this equals the total fingerling introductions between 1965 and 1973. Major efforts are in progress in estuaries to reestablish striped bass populations and to mitigate losses of fish due to power plant operation. Improved fertilization techniques in ponds should serve to increase fingerling production in the future. The use of hybrids is slowly gaining favor, both in reservoirs and in small impoundments. Reservoir management of striped bass suffers from the lack of quantification of fingerling survival and of the effects of the fish upon the forage base and upon the creel.

REPORTS OF FISHERY STATIONS, STATES, ETC.

76-001224 U.S. Department of Commerce REPORT OF THE NATIONAL MARINE FISHERIES SERVICE FOR THE CALENDAR YEAR 1975. U.S. Dep. Comm., Natl. Oceanic Atmos. Admin., Natl. Mar. Fish. Serv., Washington, D.C. vi + 45p. July 1976. SFA 21(3).

[U.S. Dep. Commerce, Washington, DC 20230]

HABITAT ALTERATION

76-001225 Hunt, R. L. A LONG-TERM EVALUATION OF TROUT HABITAT DEVELOPMENT AND ITS RELATION TO IMPROVING MANAGEMENT-RELATED RESEARCH. Trans. Am. Fish. Soc. 105 (3): 361-364. May 1976. SFA 21(3).

[Wis. Dep. Nat. Resour., Rt. 1, Box 203, Waupaca, WI 54981] Responses of a wild brook trout (*Salvelinus fontinalis*) population to instream habitat development in a 0.7 km reach of Lawrence Creek were monitored for 7 years and compared to population data for the 3-year period prior to development. Mean annual biomass of trout, mean annual number of trout over 15 cm (legal size), and annual production increased significantly during the 3 years following development, but more impressive responses were observed during the second 3 years. Maximum number and biomass and number of legal trout did not occur until 5 years after completion of development. The peak number of brook trout over 20 cm was reached the sixth year after development. Where long-term studies of aquatic systems are needed to evaluate effects of environmental perturbations, it may be desirable to deliberately delay collection of posttreatment data. Such a start-pause-finish sequence of research would provide more valid and less costly evaluations and utilize the time of researchers more efficiently.

76-001226 Prince, E. D.; Raleigh, R. F.; Corning, R. V. ARTIFICIAL REEFS AND CENTRARCHID BASSES. IN H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 498-505. 1975. SFA 21(3).

[Dep. Fish. Wildl. Sci., VPI & SU, Blacksburg, VA 24061]

76-001227 Wegener, W.; Williams, V.; McCall, T. D. AQUATIC MACROINVERTEBRATE RESPONSES TO AN EXTREME DRAWDOWN. Proc. Annu. Conf. Southeast. Assc. Game Fish Comm. 28: 126-144. 1975. SFA 21(3).

[Fla. Game Fresh Water Fish Comm., 207 W. Carroll St., Kissimmee 32741] An extreme drawdown conducted on Lake Tchopekalgia, Florida, improved littoral substrate, stimulated development of aquatic macrophytes and increased invertebrate standing crop. Benthic macroinvertebrates increased from 98 to 244 organisms per square foot in limnetic areas after reflooding: littoral benthos rose from 154 to 250 organisms per square foot. Phytomacrofauna increased from a predrawdown high of 304, to 1364 organisms per sample unit after reflooding. Standing crops decreased to predrawdown estimates within two years following peak production periods. These decreases were attributed mainly to predator cropping. Fish food organisms were favored by the drawdown, and their incidence in largemouth bass stomachs increased. As a final expression of increased production, sportfish populations which utilized these organisms nearly doubled.

HARVEST, CREEL CENSUS

76-001228 Andrews, A. K. FISHERMAN EXPENDITURES AND CAPITALIZED VALUES OF AN OKLAHOMA SMALLMOUTH BASS STREAM BISECTED BY AN IMPOUNDMENT. Proc. Annu. Conf. Southeast. Assc. Game Fish Comm. 28: 322-332. 1975. SFA 21(3).

[Okla. Coop. Fish. Res. Unit., Okla. State Univ., Stillwater 74074] A stratified, random survey was conducted from 1 August 1970 through 31 July 1971 at the 15 public access points on the unimpounded riverine flowing portions of the Mountain Fork River in McCurtain County, Oklahoma. The purpose of the study was to compare fisherman expenditures and capitalized resource values in the portions of the river above and below Broken Bow Reservoir, a flood control and hydroelectric impoundment. Of the estimated 16,485 fishermen who spent \$156,864, 8,403 fishermen above the reservoir spent \$76,757 and 8,082 fishermen below the reservoir spent \$80,107. The difference was not statistically significant. Estimated expenditures at the various access sites ranged from \$238 to \$49,322. Mean expenditure per man-day was \$9.52 for the entire river and ranged from \$3.60 to \$24.84 at different sites. The average expenditures per man-day were higher than those allowed by authorizing legislation for use in resource-loss mitigation planning, and also higher than values observed for most other rivers. Capitalized value of the remaining riverine lotic portions of the Mountain Fork River was nearly \$6 million (\$2.9 million above and \$3.1 million below Broken Bow Reservoir). The value of the portion of the river inundated by the reservoir was estimated to be \$4.2 million, based on a mean value of \$2,743 per km for sites located in habitat similar to that flooded by the reservoir.

SPORT FISHERY ABSTRACTS

76-001229 Driver, B. L.; Knopf, B. C. TEMERARY ESCAPE: ONE PRODUCT OF SPORT FISHERIES MANAGEMENT. Fisheries (Bull. Am. Fish. Soc.) 1 (2): 21,24-29. Mar.-Apr. 1976. SFA 21(3).

[U.S. Forest Serv., Rocky Mt. Forest Range Exp. Stn., Fort Collins, CO 80521] The basic theme of this paper is that sport fisheries management is management of a production process that will continue to operate in the face of increased relative scarcity as use pressures grow for the recreation-related and other goods and services that can be provided by fishery resources. The challenge is that in all areas of resource management we need to define better the social goods and services that can be provided, and then question more explicitly if they should be provided, and if so, where, when, by whom, for whom, in what amount, at what price, and who should pay the bill.--Intro.

76-001230 Fleener, G. G. HARVEST OF SMALLMOUTH BASS AND ASSOCIATED SPECIES IN COURTOIS CREEK. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 250-256. 1975. SFA 21(3).

[Mo. Dep. Conserv., Columbia 65201]

76-001231 McAllister, R. CALIFORNIA MARINE FISH LANDINGS FOR 1974. Calif. Dep. Fish Game Fish Bull. 166. 53p. 1976. SFA 21(3).

[Calif. Dep. Fish Game, Sacramento 95814]

76-001232 Moody, H. L. TOURNAMENT CATCH OF LARGEMOUTH BASS FROM ST. JOHNS RIVER, FLORIDA. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 73-82. 1975. SFA 21(3).

[Fla. Game Fresh Water Fish Comm., Eustis Res. Lab., Eustis, FL 32726] A three-day fishing tournament on the St. Johns River, Florida, in which 200 fishermen competed, yielded 1165 largemouth bass over 12 inches, and 1254 bass smaller than 12 inches. The over-all catch rate was 0.50 bass per hour. The catch per acre of water fished was 0.03 bass. Over-all mortality estimates ranged from 22.3 to 43.8 percent; they were due primarily to epidermal bacterial and fungal infections, contracted by handling. The 31-day tag retention rate for largemouth bass tagged with Floy FD-68-E anchor tag was found to be 51.1 percent for fish held in a hatchery pond.

76-001233 Parrack, M. L. ESTIMATION OF FISHING EFFORT IN THE WESTERN NORTH ATLANTIC FROM AERIAL SEARCH DATA. NOAA Fish. Bull. 74 (3): 503-515. July 1976. SFA 21(3).

[NMFS, Northeast Fish. Cent., Woods Hole, MA 02543] Three estimators of days fished were developed from aerial search data obtained by fisheries surveillance operations over the northwest Atlantic off the northeast coast of the United States. These algorithms estimate fishing effort by applying functions of past aerial observations and past reported effort to aerial data from the time period for which effort is to be calculated. An estimator based on the relation of the average number of fishing vessels that were observed per flight and days fished as reported has produced easily calculated estimates of days fished to within ± 0.50 of the reported value in 90 percent of all cases, 1971-73. An estimator based on the probability of a day fished if not sighted by fisheries surveillance operations provided an estimate of fishing effort to within ± 0.50 in 95 percent of all cases. An algorithm based on the probability of a day on fishing grounds, if not actually observed, and on the ratio of days fished to days on grounds enabled the calculation of days fished with largest error (within ± 0.50 in approximately 80 percent of all cases).

SPCRT FISHERY ABSTRACTS

REGULATIONS

76-001234 Clady, M. D.; Campbell, D. E.; Cooper, G. P. EFFECTS OF TROPHY ANGLING ON UNEXPLOITED POPULATIONS OF SMALLMOUTH BASS IN H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 425-429. 1975. SFA 21(3).

[Dep. Nat. Resour., Cornell Univ., Ithaca, NY 14850]

76-001235 England, R. H.; Fatora, J. R. WATERS CREEK--A TROPHY TROUT STREAM. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 342-351. 1975. SFA 21(3).

[Ga. Dep. Nat. Resour., Clarksville] A 4.3 km section of Waters Creek in Lumpkin County, Georgia, was managed for trophy trout with supplemental feeding under restrictive regulations, including 22 inch minimum size. Complete creel data for 3 years reveal a mean daily pressure of 31.9 anglers, and an annual mean catch rate of 0.18-0.24 fish/hr. Total anglers decreased 13.5 percent and total hours increased 18.0 percent 1972-1973. Trip length increased from 3.1 to 4.7 hr 1972-1974. An analysis of variance of catch rate means provided evidence of differences in catch rates with total daily effort. The mean catch rate of 0.51 fish/hr at 26-50 hr daily effort was significantly higher than catch rates at higher pressure. The cumulative frequency distribution of trophy catch rates was influenced by initial stockings. The mean standing crop (44.7 kg/ha) between feeding points and high density of sub-legal fish at feeding points indicate that natural recruitment may sustain the fishery. The program cost is comparable to cost of management of a put-and-take stream under equal pressure.

76-001236 Fox, A. C. EFFECTS OF TRADITIONAL HARVEST REGULATIONS ON BASS POPULATIONS AND FISHING. IN H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 392-398. 1975. SFA 21(3).

[U.S. FWS, Dep Interior, Washington, DC 20240]

76-001237 Ming, A.; McDannold, W. E. EFFECT OF LENGTH LIMIT ON AN OVERHARVESTED LARGEMOUTH BASS POPULATION. IN H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 416-424 1975. SFA 21(3).

[Mo. Dep. Conserv., Columbia]

76-001238 Warner, K. HOOKING MORTALITY OF LANDLOCKED ATLANTIC SALMON, /*SALMO SALAR*/, IN A HATCHERY ENVIRONMENT. Trans. Am. Fish. Soc. 105 (3): 365-369. May 1976. SFA 21(3).

[Me. Dep. Inland Fish. Wildl., Bangor 04401] Experiments to evaluate mortality of age I+ hatchery-reared landlocked Atlantic salmon (/Salmo salar/) caused by hooking with four terminal gear types were conducted at the Cobb Fish-cultural Station, Enfield, Maine in fall, 1972-74. For the 3 study years, there was an overall mortality of only 3.3 percent for 1,200 salmon caught by angling, and a mortality of only 0.3 percent for control fish. Of the total mortality of angled fish, 42.5 percent occurred within the first 24 hours. Worm-hooked salmon suffered significantly greater mortality (5.7 percent) than fish caught on all hardware (single- and treble-hook data combined) (/P/ less than 0.001) and by single-hook hardware only (/P/

SPORT FISHERY ABSTRACTS

76-001238 CONTINUED

less than 0.01). Fly-hooked salmon mortality (4.6 percent) was significantly greater (/P/ less than 0.01) than mortality of fish hooked on all hardware. There was no significant difference in mortality between worm-hooked and fly-hooked salmon. Mortality caused by hooking with worms was primarily from fish hooked in the eye (76 percent) and gill or gill arch (12 percent). Fly-caught mortalities had been hooked mainly in the isthmus or tongue (42 percent), esophagus or stomach (25 percent), and eye (25 percent).

FISH CONTROL AND REMOVAL

76-001239 Burress, R. M. ENHANCING BASS PRODUCTION BY THE USE OF FISH TOXICANTS. IN H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 480-488. 1975. SFA 21(3).
[U.S. FWS, Southeast. Fish Control Lab., Warm Springs, GA]

76-001240 Ellis, F. S., Jr.; Thomaston, W. W. THE USE OF ANTIMYCIN (FINTROL) IN FARM PONDS IN GEORGIA. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 103-115. 1975. SFA 21(3).

[Dep. Nat. Resour., Rt. 3, Box 7A, Fort Valley, GA 31030] The results from the use of antimycin A in Georgia fish ponds as a fish toxicant within the period 1968-1974 are presented in the following paper. Concentrations of antimycin at 0.4 to 0.6 parts per billion (ppb) were found to be the most desirable range for reducing populations of scalefish in attempting to improve balance and/or to improve fishing. For controlling all sizes of scalefish in catfish ponds, concentrations of 2.0 and 4.0 ppb seemed effective. The gravity flow method of application by boat was found to be adequate, but other means of application could be used successfully.

76-001241 Grinstead, B. G. RESPONSE OF BASS TO REMOVAL OF COMPETING SPECIES BY COMMERCIAL FISHING IN H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 475-479. 1975. SFA 21(3).

[TVA, Norris, TN]

MARKING AND TAGGING

76-001242 Donahoo, M. J. MODIFIED CARLIN-TYPE TAG FOR IDENTIFYING EXPERIMENTAL FISH. Prog. Fish-Cult. 38 (2): 88-89. Apr. 1976. SFA 21(3).

[U.S. FWS, Fish Genetics Lab., Beulah, WY 82712] The Fish Genetics Laboratory (FGL) uses a modified Carlin-type tag, here called the FGL bead tag, to identify individual salmonids 1 yr old or older. A system of 6 beads, selected from 10 distinct colors of beads fitted to a numbering system, and a 2-digit number on the blade of the FGL bead tag yields more than 13 million different number combinations. The numbering system is easily adapted to automatic data-processing procedures. The tag is easy to construct and attach to the fish. Tag retention was 90 and 80 percent for the first and second years, respectively, after tagging.

76-001243 Laurs, R. M.; Lenarz, W. H.; Nishimoto, R. N. ESTIMATES OF RATES OF TAG SHEDDING BY NORTH PACIFIC ALBACORE, /THUNNUS ALALUNGA/. NOAA Fish. Bull. 74 (3): 675-678. July 1976. SFA 21(3).
 [NMFS, Southwest Fish. Cent., La Jolla, CA 92038] Type-I (immediate) and Type-II (instantaneous) rates of tag shedding by North Pacific albacore, /Thunnus alalunga/, are estimated using data from a double-tagging experiment. Type-I shedding is estimated to be about 0.12 and Type-II to be between 0.086 and 0.098 on an annual basis. The paper also contains a discussion on the accuracy of the estimates, and a method is developed to estimate possible bias due to fishermen reporting double tag recoveries as single tag recoveries. The possible bias is estimated to be low.

76-001244 Leaman, B. M. AN INEXPENSIVE TAG FOR SHORT-TERM VISUAL TRACKING STUDIES. J. Fish. Res. Board Can. 33 (7): 1628-1629. July 1976. In English with French summ. SFA 21(3).
 [Dep. Environ., Fish. Mar. Serv., Pac. Biol. Stn., Nanaimo, BC V9R 5K6, Canada] The construction of an inexpensive tag for visual tracking studies is described. The results of field evaluation of the tag are presented and discussed in relation to previous tags and other tracking methods. Advantages of the tag are listed.

76-001245 Mears, H. C. OVERWINTER REGENERATION OF CLIPPED FINS IN FINGERLING BROOK TROUT. Prog. Fish-Cult. 38 (2): 73. Apr. 1976. SFA 21(3).
 [Maine Coop. Fish. Res. Unit, Orono 04473] Regeneration of clipped fins was studied as part of an investigation of overwinter survival of hatchery-reared fingerling brook trout (/Salvelinus fontinalis/). Fins were removed close to the base; fish were released into Giles Pond, Maine, in late October 1975 and surviving fish were recovered in April 1976. Marked fins were characteristically short and stubby and were easily identified. Regeneration had occurred in 9 percent of all fins observed. Frequency of regeneration was highest for the anal fin (41 percent) and lowest for the adipose (0.6 percent); regeneration of pectoral fins was 1.5-2 times more frequent than that of pelvic fins. Few fins regenerated to more than 50 percent of their original size.

76-001246 Slatick, E. COMPARATIVE RETENTION OF DART AND JAW TAGS ON CHINOOK SALMON AND STEELHEAD TROUT DURING THEIR SPAWNING MIGRATION. Mar. Fish. Rev. 38 (7): 24-26. July 1976. SFA 21(3).
 [NMFS, Northwest Fish. Cent., 2725 Montlake Blvd. East, Seattle, WA 98112] Adult chinook salmon (/Oncorhynchus tshawytscha/) and adult steelhead trout (/Salmo gairdneri/) were tagged alternately with either a dart tag or a jaw tag at Little Goose Dam on the Snake River in Washington State. Tagged fish were recovered from anglers, hatcheries, weirs, and spawning surveys 100-500 kilometers upstream from Little Goose Dam. Among chinook salmon sampled, 10.0 percent of the dart-tagged group and 19.7 percent of the jaw-tagged group were recovered. Recovery rate of steelhead trout tagged with dart tags was 19.6 percent and the recovery rate of the jaw tagged group was 26.4 percent. Chi-square tests supported the conclusion that jaw tags were better retained than dart tags on both chinook salmon and steelhead trout.



STOCKING AND INTRODUCTIONS

76-001247 Bailey, W. M. AN EVALUATION OF STEIPED BASS INTRODUCTIONS IN THE SOUTHEASTERN UNITED STATES. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 54-68. 1975. SFA 21(3).

[Ark. Game Fish Comm., Lonoke] Striped bass have been introduced into many inland waters of the southeastern states in an effort to establish a fishery, and to provide a biological control for clupeoid fishes. The Striped Bass Committee of the Southern Division, American Fisheries Society compiled information on the success of past introductions in 1970 and again in 1973. The information collected by the Committee is used to illustrate the successes and failures of introductions of fry, fingerlings, and adult fishes. Variables, other than size of fish at the time of stocking, were tabulated and analyzed to determine their significance in the success of introductions.

76-001248 Dillard, J. G.; Novinger, G. D. STOCKING LARGEMOUTH BASS IN SMALL IMPOUNDMENTS. IN H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 459-474. 1975. SFA 21(3).

[Mo. Dep. Conserv., Columbia 65201]

76-001249 Flick, W. A.; Webster, D. A. PRODUCTION OF WILD, DOMESTIC, AND INTERSTRAIN HYBRIDS OF BROOK TROUT (*/SALVELINUS FONTINALIS/*) IN NATURAL PONDS. J. Fish. Res. Board Can. 33 (7): 1525-1539. July 1976. in English with French summ. SFA 21(3).

[Dep. Nat. Resour., Cornell Univ., Ithaca, NY 14853] Hatchery-reared wild and domestic strains of brook trout (*/Salvelinus fontinalis/*) were released in natural lakes, and survival and growth estimated at semiannual intervals throughout the life span. Angling was restricted. Four experiments with two year-classes involved three different Adirondack Mountain (New York) wild strains and two domestic strains, a fifth experiment included two wild strains from James Bay, Quebec and a hybrid between one of these (Assinica Lake) and a New York domestic strain. Wild and hybrid strains consistently exhibited greater longevity (5-7 yr) compared with domestic (few recovered after 3 yr). Climax sizes were not much different, except the Domestic X Assinica hybrid that was substantially larger than either of the two parents. Gross production and yield to angling of any given strain cohort was correlated ($r = 0.93$) and life-span gross production was 50 percent greater for wild and hybrid groups per unit fish stocked. Biomass stocked per recruit was much larger for domestic strains, and taking this into account, the ratio of gross production to weight stocked was about 6 times greater. Increased costs of rearing nondomesticated strains, if any, must be taken into consideration in an economic evaluation, but use of wild and/or hybrid strains of trout offers significant benefits under management conditions of these experiments.

76-001250 Fraser, J. M. ASSESSMENT OF WINTER PLANTING OF HATCHERY-REARED BROOK TROUT (*/SALVELINUS FONTINALIS/*) IN SMALL PRECAMBRIAN LAKES. J. Fish. Res. Board Can. 33 (8): 1794-1797. Aug. 1976. In English with French summ. SFA 21(3).

[Ontario Minist. Nat. Resour., Fish. Wildl. Res. Br., Maple, ON L0J 1E0, Canada] Distinctively marked 8-mo-old brook trout (*/Salvelinus fontinalis/*) were planted in autumn, 14-mo-old in winter, and 16-mo-old in spring in 10 experiments conducted on five small Ontario lakes in 1970-73. Comparative recoveries were assessed by examining the

76-001250 CONTINUED

anglers' catch and by intensive sampling with gillnets 1 mo following the spring planting. Recovery of spring-planted trout (mean 39.7 percent) was significantly higher (P less than 0.01) than for winter- (15.7 percent) and autumn-planted trout (7.7 percent). Although there was evidence in one lake of predation on winter-planted trout by large brook trout and splake (*S. fontinalis*/ X *S. namaycush*/), the factors generally responsible for the large losses of winter- and fall-planted trout have not been identified.

76-001251 Li, H. W.; Moyle, P. B.; Garrett, R. L. EFFECT OF THE INTRODUCTION OF THE MISSISSIPPI SILVERSIDE (*MENIDIA AUDENS*/) ON THE GROWTH OF BLACK CRAPPIE (*POMOXIS NIGROMACULATUS*/) AND WHITE CRAPPIE (*P. ANNULARIS*/) IN CLEAR LAKE, CALIFORNIA. Trans. Am. Fish. Soc. 105 (3): 404-408. May 1976. SFA 21(3).

[Dep. Zool., Univ. Calif., Davis 95616] The growth of black crappie (*Pomoxis nigromaculatus*/) and of white crappie (*P. annularis*/) before a new forage fish, the Mississippi silverside (*Menidia audens*/), became established in Clear Lake, California, was compared to their growth after the silverside had become established. Following the establishment of the silverside, growth rates of both species were slower than the presilverside growth rates for the first two years of life, and were apparently faster beyond year II. No correlation was found between changes in climatological conditions and crappie growth patterns. The overall impact of the silverside on the crappie fishery in Clear Lake may be negative if increased juvenile mortality rates result from the smaller sizes observed at the younger age classes.

FISHING GEAR AND TECHNIQUES

76-001252 Bisson, P. A. INCREASED INVERTEBRATE DRIFT IN AN EXPERIMENTAL STREAM CAUSED BY ELECTROFISHING. J. Fish. Res. Board Can. 33 (8): 1806-1808. Aug. 1976. In English with French summ. SFA 21(3).

[Weyerhaeuser Company, Longview, WA 98632] Electrofishing stimulated a tenfold increase in total macroinvertebrate drift in an experimental stream channel. While nearly all aquatic taxa exhibited elevated drift rates during shocking, turbellarians and chironomids showed the greatest total increases. A few taxa were relatively unaffected. Except for the Chironomidae, benthic invertebrate biomasses were not significantly depressed immediately following electrofishing.

76-001253 Bloem, A. M. EVALUATION OF MINNOW TRAPS FOR ESTIMATING POPULATIONS OF JUVENILE COHO SALMON AND DOLLY VARDEN. Prog. Fish-Cult. 38 (2): 99-101. Apr. 1976. SFA 21(3).

[U.S. Forest Serv., Pac. Northwest Forest Range Exp. Stn., Juneau, AK 99802] In studies of population size, species composition, and length-frequency distributions of juvenile coho salmon (*Oncorhynchus kisutch*/) and Dolly Varden (*Salvelinus malma*/) in streams, minnow traps were shown to be size selective for salmon 51-100 mm long and for Dolly Varden 51-130 mm long. In mixed populations of coho salmon and Dolly Varden, trap catches were representative of the species composition of the total population. Tests in enclosed 15-m study sections demonstrated that the minnow trap catches were useful for indexing the fish populations, but not for accurate population estimates.

76-001254 Burress, R. M.; Bass, D. G. THANITE (ISOBORNYL THIOCYANATE) AS AN AID FOR LIVE COLLECTION OF FISHES IN FLORIDA PONDS. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 115-123. 1975. SFA 21(3).

[U.S. FWS, Southeast. Fish Control Lab., Warm Springs, GA 31830] Applications of 1.5 mg/l of Thanite were made in a 0.68-hectare hard-water pond and a 3.64-hectare soft-water pond in Florida. The 19 species of fishes collected alive represented the following families: Lepisosteidae; Anguillidae; Esocidae; Cyprinidae; Catostomidae; Ictaluridae; Aphredoderidae; Cyprinodontidae; Poeciliidae; Atherinidae; and Centrarchidae. The treatment was not effective for collecting bowfin (*Amia calva*), yellow bullheads (*Ictalurus natalis*), or brown bullheads (*I. nebulosus*). Thanite eliminated all but 20 fish (0.4 percent) in the small pond and 100 (1.4 percent) in the large pond.

76-001255 Fowles, C. R. EFFECTS OF ELECTRIC FISHING ON THE INVERTEBRATE FAUNA OF A NEW ZEALAND STREAM. N. Z. J. Mar. Freshwater Res. 9 (1): 35-43. Mar. 1975. SFA 21(3).

[Rangitikei-Wanganui Catchment Board, P.O. Box 92, Marton, New Zealand] Electric fishing experiments were made in Woolly Creek, part of the Glenariffe system of tributaries to the Rakaia River, South Island, New Zealand, during December 1972. Two operators electric fished a 25-m length of stream from the banks, with three runs in both upstream and downstream directions. Large increases in drift were caused by the electric fishing process, which had a marked effect on the Ephemeroptera and the Cligochaete families Tubificidae and Lumbriculidae. The invertebrate drift leaving the experimental reach came predominantly from the downstream 10 m section, and larger numbers were caught in drift samples when fishing proceeded in a downstream direction. This was probably because the electrode passed over invertebrates which had previously entered the drift 'higher' upstream and re-settled on the substrate lower in the reach. Electric fishing caused a loss to the drift of 9.6 percent of the total benthos in the experimental area. This was slightly more than the 8 percent decrease in benthic numbers calculated from bottom samples.

76-001256 Kjelson, M. A.; Johnson, G. N. DESCRIPTION AND EVALUATION OF A LONG-HAUL SEINE FOR SAMPLING FISH POPULATIONS IN OFFSHORE ESTUARINE HABITATS. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 171-179. 1975. SFA 21(3).

[NMFS, Atl. Estuarine Fish. Cent., Beaufort, NC 28516] A long-haul seine was designed to sample 10,000 m² of open water less than 3.5 m deep for both pelagic and semi-demersal fish populations. The net, 354 m long constructed of 20 and 25 mm bar mesh, was used to encircle the area, and by a simple method to concentrate and purse the catch in open water. Atlantic menhaden, *Brevortia tyrannus*; Atlantic thread herring, *Opisthonema oglinum*; pinfish, *Lagodon rhomboides*; and striped mullet, *Mugil cephalus* were the most abundant species collected from 60 samples taken during 1973 in the Newport River estuary (Carteret County, North Carolina). Sample to sample variation for individual species was high, with coefficients of variation usually about 100 percent. Mark-recapture experiments using a total of 232 marked fish indicated that 31 to 54 (95 confidence limits) of the marked pelagic and semi-demersal fish released in the sampled water mass were recovered.

76-001257 Meyer, H. L.; Merriner, J. V. RETENTION AND ESCAPEMENT CHARACTERISTICS OF POUND NETS AS A FUNCTION OF POUND-HEAD MESH SIZE. Trans. Am. Fish. Soc. 105 (3): 370-379. May 1976. SFA 21(3).

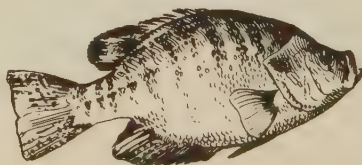
[Va. Inst. Mar. Sci., Gloucester Point 23062] Pound nets have frequently been blamed for the destruction of large quantities of undersized and immature fishes termed "scrap-fish," which include commercially and recreationally important species. Capture of these small fishes is facilitated by the 51-mm stretched mesh size commonly used in the entrapment portion, or pound-head, of the net. Series of five major fish species in the scrap landings of the lower Chesapeake Bay were used to derive theoretical and experimental 50 percent retention lengths, plus gilling frequencies in experimental pound-heads with stretched mesh sizes ranging from 38 mm to 76 mm in 6.4-mm increments. Significant gilling in stretched mesh sizes of 57 mm and larger lead to the conclusion that 51-mm stretched mesh in pound-heads is a necessary though wasteful compromise. However, an escape panel of larger mesh size, located in the pound-head, would allow escapement of small sciaenids while retaining clupeids which are utilized as bait in the blue crab fishery. /In situ/ mesh size measurements are necessary when determining selectivity characteristics of a particular pound-head.

76-001258 Stickney, R. R. INTERPRETATION OF DATA FROM OTTER TRAWL CATCHES IN A GEORGIA ESTUARY. Prog. Fish-Cult. 38 (2): 92-94. Apr. 1976. SFA 21(3).

[Dep. Wildl. Fish. Sci., Texas A & M Univ., College Station 77843] The catch from 10-min otter trawls fished at 2-h intervals over a 24-h period in a Georgia tidal creek showed significant variability which may have been related, in part, to diurnal activity patterns of the organisms captured but did not appear to be related directly to tide. Five close-interval trawls in the same creek at low tide resulted in successively decreasing biomass and abundance of organisms, although species diversity was unaffected. In the collection of fishery survey data, simultaneous sampling of all stations may be as important as, or more important than, replicate sampling at a particular station.

76-001259 Wickham, D. A.; Watson, J. W., Jr. SCUBA DIVING METHODS FOR FISHING SYSTEMS EVALUATION. Mar. Fish. Rev. 38 (7): 15-23. July 1976. SFA 21(3).

[NMFS, NOAA, Washington, DC 20235] The scuba diving methods and operational procedures used by the Harvesting Technology Group, Pascagoula Laboratory, Southeast Fisheries Center, National Marine Fisheries Service, NOAA, during the development of new fish trawl technology are described. Procedures for using diving sleds for efficient transport of divers to and from the trawls to facilitate on-the-net observations of operational bottom and mid-water trawls are provided. Procedures are described for the static deployment of bottom and mid-water trawls in fishing configuration, as required during the development of electric trawling systems. Diving safety is discussed as it relates to the use of a diving sled and to both operational and static deployment of fish trawls.



FISHWAYS, FISH PASSAGE THROUGH DAMS, ETC.

76-001260 Bentley, W. W.; Raymond, H. L. DELAYED MIGRATIONS OF YEARLING CHINOOK SALMON SINCE COMPLETION OF LOWER MONUMENTAL AND LITTLE GOOSE DAMS ON THE SNAKE RIVER. Trans. Am. Fish. Soc. 105 (3): 422-424. May 1976. SFA 21(3).

[NMFS, Northwest Fish. Cent., 2725 Montlake Blvd. East, Seattle, WA 98112] Travel time for yearling chinook salmon (*Oncorhynchus tshawytscha*) to migrate the 370 km downstream from the Salmon River to Ice Harbor Dam was compared during 3 years prior (1966-68) and 4 years after (1970-74) impounding of the Snake River behind Lower Monumental and Little Goose dams. Prior to impounding, fish averaged 15 days of travel time to Ice Harbor Dam during low flows (1,000-2,000 m³/s) and 9 days during moderate flows (2,300-4,000 m³/s). After the new impoundments, average travel time was increased to 31 days in low flows and 20 days in moderate flows--a measured delay of 16 and 11 days, respectively.

76-001261 Nusenbaum, L. M.; Lemanova, N. A. THE STATE OF THE OVARIES OF THE SHAD, *CASPIALOSA KESSLERI*, PASSED THROUGH THE VOLGOGRAD FISH LIFT. J. Ichthyol. (Engl. Transl. Vopr. Ikhticl.) 15 (2): 274-278. 1975. SFA 21(3).

[GosNIORKh, Leningrad, USSR] A large number of females of the shad, *Caspialosa kessleri*, pass through the fish lift after laying the first batch of eggs in the afterbay of the Volgograd hydroelectric power plant. In some females oocyte resorption was observed, which may be connected with the high water temperatures. According to the histologic patterns of the oocytes of different generations, 5 states of the ovary are distinguished. The question of the suitability of the passage of shad into the forebay of the hydroelectric power plant is discussed.

MATHEMATICS, STATISTICAL METHODS AND MODELING

76-001262 Bergersen, E. P.; Keefe, T. J. AN INDEX OF FISH MOVEMENT WITH STATISTICAL TECHNIQUES FOR ITS INTERPRETATION. J. Fish. Res. Board Can. 33 (7): 1649-1652. July 1976. In English with French summ. SFA 21(3).

[Colo. Coop. Fish. Res. Unit., Colo. State Univ., Fort Collins 80523] A measure of the strength of association between two categorical variables (location of initial marking and location of recapture) is proposed as an index of the extent of fish movement in streams. Confidence intervals and tests of significance for interpretation of the strength of association are presented, along with their development and theoretical justification. The proposed methodology is applied to fish movement data collected before and after pollution-abatement periods in a river in northern Utah.

76-001263 Kerr, S. R.; Neal, M. W. ANALYSIS OF LARGE-SCALE ECOLOGICAL SYSTEMS. J. Fish. Res. Board Can. 33 (9): 2083-2089. Sept 1976. In English with French summ. 21(3).

[Dep. Environ., Fish. Mar. Serv., Mar. Ecol. Lab., Bedford Inst. Oceanogr., Dartmouth, NS B2Y 4A2, Canada] Large spatial and temporal scales imply a proportional need for large volumes of data. Ecological systems exhibit different patterns of variability as a function of scale. It follows that large-scale ecological systems are appropriately observed at a number of different spatial and temporal scales, further complicating the data requirements for various kinds of analysis. The concept of an "information model," in conjunction with an effective data base management system, enables an analytical approach to large-scale ecological systems that is relatively unconstrained by preconceived organizational structures in the data base.

76-001264 Kriksunov, E. A.; Sidorin, A. P. MODELING GROWTH AND MORTALITY INTERRELATIONSHIP IN A POPULATION OF SHORT-CYCLE FISH THE SMELT, /OSMERUS PERLANUS/ MORPHA /SPIRINCHUS/, CF PSKOVSKO-CHUDSKOE LAKE WITH ENVIRONMENTAL CHANGES CONSIDERED. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (4): 542-549. 1975. SFA 21(3).

[IEMEZh, Moscow, USSR] An approach is described to modeling the population dynamics of a short-cycle fish. In view of the absence in such populations of a sufficiently complex age structure, and as a result of this clearly expressed instability of their dynamics, modeling of the population dynamics of such fish possesses a number of peculiarities. These peculiarities consist of the necessity of introducing into the modeling algorithm descriptions of the basic processes that form the dynamics of separate generations of the fish, the necessity to take into consideration both intra-, and inter-annual variability of the basic factors of the environment, and the selection of a time scale for the model, commensurate with the processes that form the population dynamics of short-cycle fishes in specific periods of their ontogeny.

76-001265 Vaughan, D. S.; Saila, S. B. A METHOD FOR DETERMINING MORTALITY RATES USING THE LESLIE MATRIX. Trans. Am. Fish. Soc. 105 (3): 380-383. May 1976. SFA 21(3).

[Grad. Sch. Oceanogr., Univ. R.I., Kingston 02881] The Leslie matrix algorithm has been utilized to estimate mortality of a year class assuming an equilibrium population for a species. Under this assumption an estimate of the mortality for the 0th year class of the Atlantic bluefin tuna (/Thunnus thynnus thynnus/) has been made indicating about five survivors from 10 million eggs in the first year of life. The mortality rates for later year classes were derived from empirical data.

76-001266 Zuboy, J. R.; Lackey, R. T. A COMPUTER SIMULATION MODEL OF A MULTISPECIES CENTRARCHID POPULATION COMPLEX. Va. J. Sci. 26 (1): 13-19. 1975. SFA 21(3).

[Dep. Fish. Wildl. Sci., VPI & SU, Blacksburg, VA 24061] The development and structure of STOCKS, a computer simulation model of a multispecies centrarchid population complex, is discussed. STOCKS emphasizes dynamic interrelationships among three game fishes: bluegill (/Lepomis macrochirus/), largemouth bass (/Micropterus salmoides/), and black crappie (/Pomoxis nigromaculatus/). Required input data for each species are: (1) an initial population estimate; (2) estimated high, medium, and low annual recruitment with a standard deviation for each; (3) annual natural mortality rate; and (4) annual fishing mortality rate. Simulator output is: (1) a population estimate

76-001266 CONTINUED

for each species each year; (2) catch of each species for each year; (3) mean catch of each species for all years. Analysis of a large number of computer runs under various input conditions is discussed. STOCKS is not offered as the solution to the multispecies management problem, but rather as an approach to better understanding the dynamics of centrarchid population complexes.

76-001267 Zweifel, J. R.; Lasker, R. PREHATCH AND POSTHATCH GROWTH OF FISHES--A GENERAL MODEL. NOAA Fish. Bull. 74 (3): 609-621. July 1976. SFA 21(3).

[NMFS, Southwest Fish. Cent., La Jolla, CA 92038] The developmental stages of fish eggs and the growth of larval fishes of several species can be represented by a Gompertz-type curve based on the observation that in widely different living systems, exponential growth tends to undergo exponential decay with time. Further, experimental studies and field observations have shown that the effect of temperature on the growth process follows the same pattern, i.e., the rate of growth declines exponentially with increasing temperature. Evidence suggests that pre hatch growth rates determine ideal or optimum trajectories which are maintained after hatch in the middle temperature range but not at either extreme. Also, post hatch growth exhibits a temperature optimum which is not apparent in the incubation period. These studies have also shown that for the same spawn both the pre hatch and yolk-sac growth curves reach asymptotic limits independent of temperature. Other biological events (e.g., jaw development) occur at the same size for all temperatures. The growth of post-yolk-sac larvae follows a curve of the same type and hence the post hatch growth trajectory may be represented by a two-stage curve. For starving larvae, the second stage shows a decline in size but maintains the same form, i.e., the rate of exponential decline decreases exponentially with time.

LAKE MANAGEMENT & RESEARCH

76-001268 Carlander, K. D. COMMUNITY RELATIONS OF BASS, LARGE NATURAL LAKES. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 125-130. 1975. SFA 21(3).
[Dep. Fish., Iowa State Univ., Ames 50010]

76-001269 Latta, W. C. DYNAMICS OF BASS IN LARGE NATURAL LAKES. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 175-182. 1975. SFA 21(3).
[Mich. Dep. Nat. Resour., Inst. Fish. Res., Ann Arbor]

76-001270 Powell, D. H. MANAGEMENT OF LARGE MOUTH BASS IN ALABAMA'S STATE-OWNED PUBLIC FISHING LAKES. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 386-390. 1975. SFA 21(3).
[Fish. Sect., Ala. Game Fish Div., 64 N. Union St., Montgomery 36104]

76-001271 Reich, K. PROBLEMS OF FISHERIES RESEARCH IN LAKE KINERET. Bamidgah 28 (1/2): 3-11. 1976. SFA 21(3).
[Hebrew Univ., Dep. Zool. Minist. Agric., Dep. Fish., Rehovoth, Israel]

RIVER AND STREAM MANAGEMENT & RESEARCH

76-001272 Fajen, O. POPULATION DYNAMICS OF BASS IN RIVERS AND STREAMS. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 195-203. 1975. SFA 21(3).
[Mo. Dep. Nat. Resour., Columbia 65201]

76-001273 Funk, J. L.; Pflieger, W. L. COURTOIS CREEK, A SMALLMOUTH BASS STREAM IN THE MISSOURI OZARKS. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 224-230. 1975. SFA 21(3).
[Mo. Dep. Conserv., Columbia 65201]

76-001274 Funk, J. L. EVALUATION OF THE SMALLMOUTH BASS POPULATION AND FISHERY IN COURTOIS CREEK. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 257-269. 1975. SFA 21(3).
[Mo. Dep. Conserv. Columbia 65201]

76-001275 Funk, J. L. STRUCTURE OF FISH COMMUNITIES IN STREAMS WHICH CONTAIN BASS. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 140-153. 1975. SFA 21(3).
[Mo. Dep. Conserv., Columbia 65201]

76-001276 Sutherland, A. J.; Ogle, D. G. EFFECT OF JET BOATS ON SALMON EGGS. N. Z. J. Mar. Freshwater Res. 9 (3): 273-282. Sept. 1975. SFA 21(3).

[Civ. Eng. Dep., Univ. Canterbury, Christchurch, New Zealand] The passage of jet boats through spawning areas can kill salmon eggs buried in the river bed. By using a jet boat on the Ashley River the pressure gradients created in a redd were determined. At the maximum boat speed investigated ($11 \text{ m}\cdot\text{s}^{-1}$) gradients up to $9.32 \text{ kPa}\cdot\text{m}^{-1}$ were recorded. The induced water velocities through the gravel were then estimated from the equation of motion and reproduced in a gravel-filled tube in the laboratory. For the test conditions discharge velocities ranged from 0.18 - $0.3 \text{ m}\cdot\text{s}^{-1}$. Studies of the effect of these flows on salmon eggs revealed fatality rates of up to 40 percent at their most critical stage on the ninth day of development.

76-001277 Tennant, D. L. INSTREAM FLOW REGIMENS FOR FISH, WILDLIFE, RECREATION AND RELATED ENVIRONMENTAL RESOURCES. Fisheries (Bull. Am. Fish. Soc.) 1 (4): 6-10. July-Aug. 1976. SFA 21(3).

[U.S. FWS, Federal Bldg., Billings, MT 59101] a quick, easy methodology is described for determining flows to protect the aquatic resources in both warmwater and coldwater streams, based on their average flow. Biologists do their analysis with aid of hydrological data provided by the U.S. Geological Survey (USGS). Detailed field studies were conducted on 11 streams in 3 states between 1964 and 1974, testing the "Montana Method." This work involved physical, chemical,

76-001277 CONTINUED

and biological analyses of 38 different flows at 58 cross-sections on 196 stream-miles, affecting both coldwater and warmwater fisheries. The studies, all planned, conducted, and analyzed with the help of state fisheries biologists, reveal that the condition of the aquatic habitat is remarkably similar on most of the streams carrying the same portion of the average flow. Similar analyses of hundreds of additional flow regimens near USGS gages in 21 different states during the past 17 years substantiated this correlation on a wide variety of streams. Ten percent of the average flow is a minimum instantaneous flow recommended to sustain short-term survival habitat for most aquatic life forms. Thirty percent is recommended as a base flow to sustain good survival conditions for most aquatic life forms and general recreation. Sixty percent provides excellent to outstanding habitat for most aquatic life forms during their primary periods of growth and for the majority of recreational uses.

FARM POND AND SMALL IMPOUNDMENT MANAGEMENT

76-001278 Hackney, P. A. BASS POPULATIONS IN PONDS AND COMMUNITY LAKES. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 131-139. 1975. SFA 21(3).
[Browns Ferry Biothermal Res. Lab., Decatur, AL]

76-001279 Hooper, A. D. ENHANCEMENT OF BASS PRODUCTION BY FERTILIZATION AND FEEDING. IN H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 506-512. 1975. SFA 21(3).

76-001280 Nail, M. L.; Powell, D. H. OBSERVATIONS ON SUPPLEMENTAL FEEDING OF A 75-ACRE LAKE STOCKED WITH LARGEMOUTH BASS, BLUEGILL, REDEAR, AND CHANNEL CATFISH. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 378-384. 1975. SFA 21(3).

[Ala. Dep. Conserv. Nat. Resour., Game Fish Div., Montgomery]
Barbour County Public Fishing Lake (75 acres) was stocked with approximately 500 channel catfish per acre in combination with the normal stocking rates of largemouth bass, bluegill, and redear sunfish. The lake was supplementally fed on one side only, in addition to receiving a regular fertilization program. At the end of one year of fishing, 305.5 fishermen per acre had harvested 621.8 pounds of fish per acre. Of this total, bluegill comprised 381 pounds per acre. There was no significant difference between the weights of bluegill collected from the fed and non-fed areas. There was a significant difference between the weights of bluegill collected shortly after the feeding program was initiated and bluegill collected 14 months later. Bluegill from Barbour County Public Fishing Lake were significantly heavier for a given length as compared to bluegill from three public lakes.

76-001281 Smith, B. W.; White, C. E., Jr.; Hooper, G. R. MANAGEMENT TECHNIQUES FOR LARGEMOUTH BASS IN ALABAMA PONDS. IN H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 380-385. 1975. SFA 21(3).

[Fish. Sect., Ala. Game Fish Div., 64 N. Union St., Montgomery 36104]

76-001282 Smitherman, R. O. EXPERIMENTAL SPECIES ASSOCIATIONS OF BASSES IN ALABAMA PONDS. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 76-84. 1975. SFA 21(3).

[Dep. Fish., Auburn Univ., Auburn, AL 36830]

76-001283 Snow, J. R. FISH PRODUCTION IN A CENTRAL ALABAMA STOCK WATER POND. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 217-221. 1975. SFA 21(3).

[Auburn Univ. Agric. Exp. Stn., Auburn Univ., Auburn, AL 36830] The use of suitably constructed and located stock water ponds for food fish culture is recommended, based upon investigation into the possibilities of these small bodies of water to rear a channel catfish-largemouth bass combination. Stocked with 2,000 catfish and 100 bass per acre with supplemental feeding, two, two-year production cycles showed the following results: total fish production, 2,634 and 3,791 pounds per acre; feed conversion, 2.5 and 2.4; recovery of stocked catfish, 84 and 91 percent; recovery of stocked bass, 40 and 50 percent. In addition to supplying food fish, the pond provided recreation through the fish cultural activity and by hook and line fishing.

LARGE IMPOUNDMENT MANAGEMENT & RESEARCH

76-001284 Archer, D. L.; Loyacano, H. A., Jr. INITIAL AND DELAYED MORTALITIES OF LARGEMOUTH BASS CAPTURED IN THE 1973 NATIONAL KEOWEE B.A.S.S. TOURNAMENT. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 90-96. 1975. SFA 21(3).

[Utah Div. Wildl. Resour., Cedar City 84720] Tournament-caught largemouth bass were compared with hatchery bass to determine survival rates of bass injected or uninjected with oxytetracycline. Significant mortality rates occurred only in injected tournament-caught bass held in plastic pools. Hatchery controls, uninjected tournament bass and injected tournament bass held in hatchery ponds exhibited mortality rates similar to each other. Survival was best in hatchery ponds, but not significantly better than in pools except for injected tournament-caught bass.

76-001285 Axon, J. R. REVIEW OF COLDWATER FISH MANAGEMENT IN TAILWATERS. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 351-355. 1975. SFA 21(3).

[Dep. Fish Wildl. Resour., Frankfort, KY] A trend in the stocking procedure of trout in tailwaters has developed as an outcome of increasing fishing pressure. Fingerling stocking of trout was initially recommended in tailwaters where an adequate food supply was available, and predation by predatory fish was not considered a problem. Eventually, fishing pressure increased and the fingerling trout were harvested before reaching a desirable size necessary to maintain a quality put-grow-and-take fishery. Consequently, stocking of larger catchable-size trout was resorted to; this procedure resulted in a quality put-and-take fishery. Several basic concepts pertaining to the development of trout fisheries in tailwaters were conceived after intensive investigation. The fishing pressure and harvest must first be known in order to stock trout at a proper rate and at the proper time to sustain a quality fishery. One technique that has had a great impact on the harvest in tailwaters that are relatively inaccessible to bank and wading anglers is the development of boat fishing. The major problem of most tailwater trout fisheries

76-001285 CCNTINUED

is that of erratic flow; a more sustained flow would provide better fishing conditions, alleviate periods of low-dissolved-oxygen levels and elevated water temperatures that are detrimental to trout, and prevent periods of high flow that can retard bottom fauna productivity and consequent trout growth.

76-001286 Chance, C. J.; Smith, A. O.; Holbrook, J. A. II; Fitz, R. B. NORRIS RESERVOIR: A CASE HISTORY IN FISH MANAGEMENT. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 399-407. 1975. SFA 21(3)
[Fish. Waterfowl Br., TVA, Norris, TN]

76-001287 Jenkins, R. M. BLACK BASS CROPS AND SPECIES ASSOCIATIONS IN RESERVOIRS. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 114-124. 1975. SFA 21(3).
[U.S. FWS, Fayetteville, AR]

76-001288 Keith, W. E. MANAGEMENT BY WATER LEVEL MANIPULATION. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 489-497. 1975. SFA 21(3).
[Ark. Game Fish Comm., Little Rock]

76-001289 Plumb, J. A.; Gaines, J. L.; Gennings, M. EXPERIMENTAL USE OF ANTIBIOTICS IN PREVENTING DELAYED MORTALITY IN A BASS TOURNAMENT ON LAKE SEMINOLE, GEORGIA. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 87-90. 1975. SFA 21(3).
[Dep. Fish. Allied Aquacult., Ala. Agric. Exp. Stn., Auburn Univ., Auburn] Oxytetracycline, as a prophylaxis against secondary bacterial infections, was injected into 531 largemouth bass (*Micropterus salmoides*) which were caught during a fishing tournament on Lake Seminole, Georgia. The injected fish, along with 531 control bass, were held for observation in a 1-acre canal contiguous with the lake. After 19 days, 4.3 percent of the injected fish had died and 2.2 percent of the control fish had died. The oxytetracycline was not beneficial in reducing mortality in the released bass.

76-001290 Rideout, S. G.; Oatis, P. H. FCFULATION DYNAMICS OF SMALLMOUTH AND LARGEMOUTH BASS IN QUABBIN RESERVOIR. In H. Clepper, ed. Black Bass Biology and Management. Sport Fishing Inst., Washington, D.C. 216-221. 1975. SFA 21(3).
[Mass. Div. Fish Game, Westboro]

76-001291 Seidensticker, E. P. MORTALITY OF LARGEMOUTH BASS FOR TWO TOURNAMENTS UTILIZING A "DON'T KILL YOUR CATCH" PROGRAM. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 83-86. 1975. SFA 21(3).
[Texas Parks Wildl. Comm., Austin 78701] A study of two bass tournaments was undertaken on Lakes Sam Rayburn and Toledo Bend in March, 1974 to evaluate a "Don't Kill Your Catch" program initiated by the Bass Anglers Sportsmen's Society. Mortality of fish held in live-wells or water tanks up to the point and just after "weigh-in" was determined. Delayed mortality was measured by taking a sample from the tournament-caught bass and stocking them in hatchery ponds for 28 days. A treatment of Terramycin was given to a portion of these hatchery-held fish to evaluate its use for improving survival of the fish. Total mortality of fish taken in both tournaments was considered low (32 per cent of the harvested fish). Tournament fish stocked in hatchery ponds and treated with Terramycin had similar survival rates

76-001291 CCNTINUED
to those of stocked untreated fishes.

76-001292 Wegener, W.; Williams, V. FISH POPULATION RESPONSES TO IMPROVED LAKE HABITAT UTILIZING AN EXTREME DRAWDOWN Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 28: 144-161. 1975. SFA 21(3).

[Fla. Game Fresh Water Fish Comm., 207 W. Carroll St., Kissimmee 32741] An extreme drawdown conducted on Lake Tohopekaliga rejuvenated littoral substrate, stimulated development of desirable aquatic plants and increased macroinvertebrate production. As a result of these beneficial changes standing crops of fish in littoral areas increased from a high of 191 pounds per acre before the drawdown to 455 pounds per acre within two years after reflooding. Limnetic standing crops increased from 59 pounds per acre to 127 pounds per acre during the same period. Biomass of sportfish nearly doubled, although forage fish accounted for a higher percentage of the population following reflooding. Individual species response to the drawdown varied. Numbers of harvestable size sportfish increased following reflooding. The monetary value of the Lake Tohopekaliga fishery increased by 37 percent, or \$6,222,186.

MARINE MANAGEMENT & RESEARCH

76-001293 Ricker, W. E. REVIEW OF THE RATE OF GROWTH AND MORTALITY OF PACIFIC SALMON IN SALT WATER, AND NONCATCH MORTALITY CAUSED BY FISHING. J. Fish. Res. Board Can. 33 (7): 1483-1524. July 1976. In English with French summ. SFA 21(3).

[Dep. Environ., Fish. Mar. Serv., Pac. Biol. Stn., Nanaimo, BC V9R 5K6, Canada] Mortality (other than landed catch) caused by pelagic gillnetting is estimated to be equal to the catch, for salmon in their penultimate year of life, and equal to about a quarter of the catch for salmon in their final year of life. Mortality caused by trolling for coho (*Oncorhynchus kisutch*) and chinook salmon (*O. tshawytscha*) averages about one fish killed (mostly below legal size) for every two that are boated. The natural mortality rate for sockeye salmon (*O. nerka*) in their final year of life averages about 0.015 per mo and is somewhat more in earlier years of pelagic life; the greater part of natural mortality after the smolt stage occurs during the downstream migration and early months of "coastal" life. For coho and chinook the best natural mortality estimate for the last year of life is 0.013 per mo, and that for pink (*O. gorbuscha*) and chum (*O. keta*) is of the same order. Growth rates during the final growing season vary from 0.26 per mo for pink and coho salmon to 0.06 per mo for chinook in their 5th ocean yr. Gains from ceasing to take immature salmon on the high seas range up to 300 percent of the catch now being taken in that category, while for fish taken in their final year they range up to about 70 percent, depending on the time of year at which the fishing is done. Gains from transferring existing pelagic net fisheries to the coastal region would be 76 percent (North American sockeye) and 86 percent (Asian sockeye) of the weight of fish now caught pelagically. Gains in total yield of existing salmon fisheries (pelagic and coastal) are estimated as 78 percent for Asian pink salmon and 72 percent for Asian sockeye. The increase in weight of the total catch from discontinuing ocean trolling for Columbia River chinook salmon and increasing river fishing correspondingly is estimated tentatively as between 63 and 98 percent.

76-001294 Sakagawa, G. T.; Coan, A. L.; Holzapfel, E. P. LENGTH COMPOSITION OF YELLOWFIN, SKIPJACK, AND BIGEYE TUNAS CAUGHT IN THE EASTERN TROPICAL ATLANTIC BY AMERICAN PURSE SEINERS. NCAA Tech. Rep. NMFS SSRF- 702. iv + 22p. Aug. 1976. SFA 21(3).

[NMFS, Southwest Fish. Cent., La Jolla, CA 92038] Sampling and analytical procedures that are used to estimate the size composition of Atlantic tunas caught by American purse seiners in the eastern tropical Atlantic are described. The procedures are based on a stratified, two-stage subsampling model. Estimates indicated that about 0.2 to 1.4 million yellowfin tuna, *Thunnus albacares*, 1.2 to 12.8 million skipjack tuna, *Katsuwonus pelamis*, and 0.5 to 41.2 thousand bigeye tuna, *T. obesus* were caught annually by the fleet in 1968-74. The dominant age group in most years was 1-yr olds for yellowfin and skipjack tuna and 2-yr olds for bigeye tuna.

76-001295 Skud, B. E. THE SPORT FISHERY FOR HALIBUT: DEVELOPMENT, RECOGNITION AND REGULATION. Int. Pac. Halibut Comm. Tech. Rep. No. 13. 19p. 1975. SFA 21(3).

[International Pacific Halibut Commission, P.O. Box 5009, University Station, Seattle, WA 98105] Estimates of the numbers and poundage of sport-caught halibut are based on information provided by state and federal agencies in the Pacific Northwest. Record sizes of trophy fish and the effect of the sport catch on stock abundance are discussed. Before 1973, the International Pacific Halibut Commission (IPHC) assumed that the Halibut Convention did not provide the authority to regulate the sport fishery, and sport regulations were considered unnecessary and unenforceable. In 1971, legal interpretations from the Canadian and U.S. Governments agreed that the Convention provided the necessary authority. In response to proposals by federal and state agencies, IPHC established sport regulations in 1973 that provided an 8-month season with limitations on the daily catch and the gear. The implementation of these regulations and the interpretations of the Convention guidelines regarding the authority to manage the sport fishery are discussed.

UTILIZATION OF FISHERY PRODUCTS

76-001296 Gadbois, D. F.; Ravesi, E. M.; Lundstrom, R. C. OCCURRENCE OF VOLATILE N-NITROSAMINES IN JAPANESE SALMON RICE. NOAA Fish. Bull. 74 (3): 683-686. July 1976. SFA 21(3).

[NMFS, Northeast Util. Res. Cent., P.O. Box 61, Gloucester, MA 01930]

MISC. TECHNIQUES AND EQUIPMENT

76-001297 Norton, V. M.; Nishimura, H.; Davis, K. B. A TECHNIQUE FOR SEXING CHANNEL CATFISH. Trans. Am. Fish. Soc. 105 (3): 460-462. May 1976. SFA 21(3).

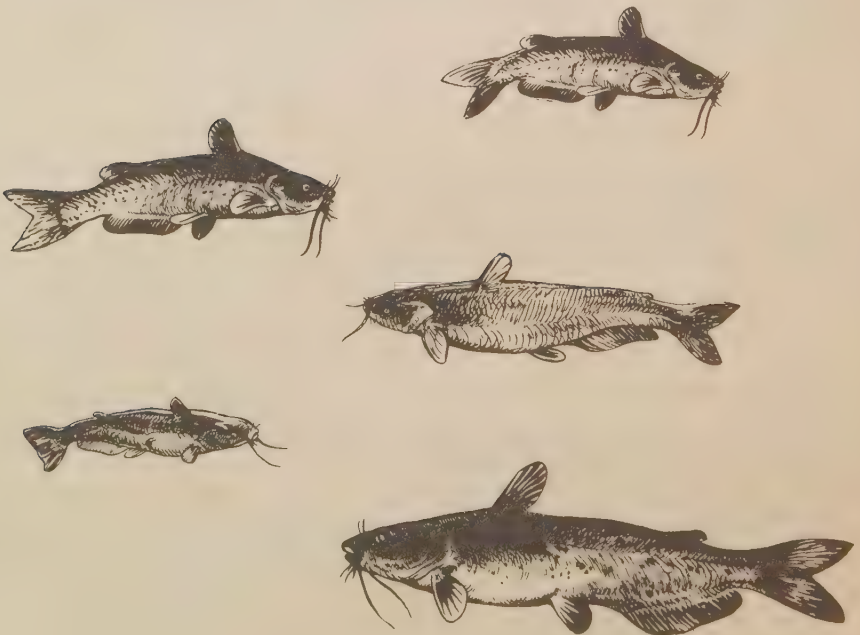
[Dep. Biol., Memphis State Univ., Memphis, TN 38152] A simple, accurate technique has been devised to sex externally channel catfish, *Ictalurus punctatus*, regardless of body size or state of gonadal maturation. Male catfish have a single urogenital opening; females have two openings partitioned by a septum--an anterior genital pore, and a posterior urinary pore. In male fish, a single probe can be inserted into the urinary bladder through the urogenital pore. Female fish are differentiated from males by the insertion of two probes, one

76-001297 CONTINUED

into the urinary bladder through the urinary pore and the second into the oviduct through the genital pore.

76-001298 Peterson, M. L.; Clay, C. S.; Brandt, S. B. ACOUSTIC ESTIMATES OF FISH DENSITY AND SCATTERING FUNCTION. J. Acoust. Soc. Am. 60 (3): 618-622. Sept. 1976. SFA 21(3).

[Gulf Oil Corp., New Orleans, LA 70160] The amplitude of a sonar echo from a fish depends upon the species and size of the fish, acoustic wavelength, aspect, position of the fish in the sonar beam, range and backscattering cross section. We simplify the problem to a single species and size of fish, vertically downward echo sounding, single aspect, and nonoverlapping echoes. After removal of attenuation due to range and absorption two random functions remain. The position of the fish in the sonar beam is random and the scattering cross section for each trial is random. We assume that the fish have a uniform density (number/m³) and calculate the probability density function (PDF) for insonification and reception. We assume that the PDF of the envelope of the echo (excluding the variability of insonification and reception) has a Rayleigh PDF. Assuming two PDF's are independent, we calculate the PDF of the echo envelopes $w/(E)(e)$. $w/(E)(e)$ depends upon the beam width of the sonar and the mean backscattering cross section. The theoretical PDF has the same shape as the measured PDF of echos from alewife in Lake Michigan. We use the fit of the PDF's to estimate the backscattering cross section and fish density. This calibrates the echo-integration processing system. A profile of the density of alewife in Lake Michigan is shown.



AUTHOR INDEX

Abdullah, M. I.
 76-001175
 Abdurakhmanov, Yu. A.
 76-001023
 Able, K. W.
 76-001136
 Acompanado, G.
 76-001164
 Acton, A. B.
 76-001163
 Adams, S. M.
 76-001044
 76-001045
 Addison, R. F.
 76-001176
 Adelman, I. R.
 76-001177
 Adelman, I. R.
 76-001178
 76-001204
 Aggus, L. R.
 76-001126
 Alderdice, D. F.
 76-001200
 Alekperov, A. P.
 76-000919
 Alekseyeva, K. D.
 76-000976
 Allan, D. J.
 76-001186
 Allan, R. C.
 76-001051
 Amend, D. F.
 76-001154
 Anderson, R. J.
 76-000942
 Anderson, R. O.
 76-001214
 Andrews, A. K.
 76-001228
 Anonymous
 76-001165
 Archer, D. L.
 76-001284
 Arnason, A.
 76-001010
 Arthur, D. K.
 76-001073
 Avault, J. W., Jr.
 76-000929
 76-000933
 76-000969
 76-000986
 Avila, V. L.
 76-001052
 Axon, J. R.
 76-001285
 Backus, N.
 76-001092
 Bailey, W. M.
 76-001247
 Bakhmin, Ye. K.
 76-000966
 Banks, J. W.
 76-001175
 Barwick, D. H.
 76-000940
 Bass, D. G.
 76-001254
 Bass, D. G., Jr.
 76-001024
 Bass, G.
 76-001035
 Benfield, E. F.
 76-000961
 Benoit, D. A.
 76-001191
 Bentley, W. W.
 76-001260
 Bergersen, E. P.
 76-001262
 Berry, C. R.
 76-000914
 Bills, T. D.
 76-001179
 Bishop, R. D.
 76-000922
 Bisson, P. A.
 76-001252
 Bloom, A. M.
 76-001253
 Bouck, G. R.
 76-001161
 Bowering, W. R.
 76-001025
 Brady, D. K.
 76-000956
 Brandt, S. B.
 76-001298
 Brannon, E. L.
 76-000918
 Braschler, E. W.
 76-000923
 Breder, C. M., Jr.
 76-001012
 Brenner, F. J.
 76-001180
 Broderius, S. J.
 76-001204

AUTHOR INDEX

Brooks, R. R.

76-001181

Brothers, E. B.

76-001139

Brown, G. W., Jr.

76-001182

Brusven, M. A.

76-000960

Bryan, C. F.

76-001106

Buckley, E.

76-001130

Buckner, J. L.

76-001211

Bulkley, E. V.

76-001183

Bumpus, R.

76-001010

Burdak, V. D.

76-000964

Burlakov, A. B.

76-000977

Burns, J. R.

76-000978

Burr, B. M.

76-000965

76-001104

76-001105

Burress, R. M.

76-001239

76-001254

Buttner, J. K.

76-001155

Cadwallader, P. L.

76-001074

76-001075

Cadwallar, P. L.

76-001076

Campbell, D. E.

76-001234

Campbell, G. C.

76-001158

Carlander, K. D.

76-001268

Carscadden, J. E.

76-001068

Casterlin, M. E.

76-001019

76-001020

Cech, J. J., Jr.

76-000979

Chance, C. J.

76-001286

Cheetham, J. L.

76-001013

Chernyshov, V. I.

76-000980

Chervinski, J.

76-000981

Chess, J. R.

76-001081

Chew, E. L.

76-001026

Chhorn, L.

76-000943

Childers, W. F.

76-000927

Chitty, N.

76-001112

Choi, Y.-H.

76-001147

Chung, H.-Y.

76-001156

Clady, M. D.

76-001127

76-001234

Clark, R. D., Jr.

76-001215

Clarke, T. A.

76-001067

Clay, C. S.

76-001298

Clepper, H.

76-001216

Clugston, J. P.

76-001170

76-001171

Coan, A. L.

76-001294

Coble, D. W.

76-001027

Coggins, J. R.

76-001158

Colin, P. L.

76-001077

Colle, D. E.

76-001152

Collins, J.

76-001166

Conner, J. V.

76-001106

Connors, R. E.

76-001158

Conrad, D. D. W.

76-000957

Cook, G. H.

76-001196

Cooper, G. P.

76-001234

Corbett, S.

76-001180

AUTHOR INDEX

Corning, R. V.

76-001226

Coutant, C. C.

76-001014

Craig, P. C.

76-001028

Crawford, D. L.

76-000953

Cross, G. H.

76-001217

Cunningham, C. C.

76-000957

Danil'chenko, O. P.

76-001184

Danilov, M. N.

76-001053

Darkov, A. A.

76-001015

Davis, J. C.

76-001185

Davis, K. B.

76-000982

76-001297

de Vlaming, V. L.

76-000998

DeLaney, R. G.

76-000983

Delisle, C. E.

76-001186

Dell, R. K.

76-000955

Deniskin, P. G.

76-000994

Denoncourt, R. F.

76-001107

Deyoe, C. W.

76-000941

Dillard, J. G.

76-001248

Dillon, P. J.

76-000959

Dmitrenko, E. M.

76-001095

Dolinin, V. A.

76-000984

Donahoo, M. J.

76-001242

Donaldson, E. M.

76-000989

Donaldson, L. R.

76-000918

Dove, G. R.

76-000941

Driver, B. L.

76-001229

Druzhinin, A. D.

76-001029

Dudnik, Yu. I.

76-001108

Duka, L. A.

76-001078

Dunn, B. P.

76-001187

Dye, H. M.

76-000989

Ebel, W. J.

76-001157

Edgar, R. K.

76-001079

Eggers, D. M.

76-001016

Eggleston, D.

76-001096

Eipper, A. W.

76-001128

Eiriksdottir, G.

76-001066

Elder, R. D.

76-001030

Eldon, G. A.

76-001037

El-Kandelgy, S. M.

76-001205

Elliot, G. V.

76-001126

Ellis, F. S., Jr.

76-001240

El-Shawy, F. M.

76-000985

England, R. H.

76-001235

Engstrom-Heg, R.

76-001212

Esch, G. W.

76-001158

Faber, D. J.

76-001137

Fajen, O.

76-001046

76-001272

Farrell, M. P.

76-001209

Farwell, M. K.

76-001031

Fatora, J. R.

76-001235

Fava, J. A.

76-001188

Fedorov, V. V.

76-001138

AUTHOR INDEX

- Pilyushina, Ye. Ye.
 76-000966
 Fishman, A. P.
 76-000983
 Fitz, R. B.
 76-001286
 Fleener, G. G.
 76-001230
 Flick, W. A.
 76-001249
 Flickinger, S. A.
 76-000942
 Forester, J.
 76-001202
 Forrester, C. R.
 76-001163
 Fowles, C. R.
 76-001255
 Fox, A. C.
 76-000915
 76-001091
 76-001236
 Franz, R.
 76-001115
 Fraser, J. M.
 76-001250
 Fry, F. E. J.
 76-001018
 Funk, J. L.
 76-001273
 76-001274
 76-001275
 Gabriel, W. L.
 76-001068
 Gadbois, D. F.
 76-001296
 Gaines, J. L.
 76-001289
 Gale, C. A.
 76-001054
 Gale, W. F.
 76-001054
 Galkin, A. S.
 76-001055
 Gall, G. A. E.
 76-000928
 Garrett, R. L.
 76-001251
 Garrick, J. A. F.
 76-000967
 Garten, C. T., Jr.
 76-001013
 Gebhart, G. E.
 76-001069
 Gennings, M.
 76-001289
 Germann, J. F.
 76-000924
 76-001032
 Gilbert, C. R.
 76-001115
 Glebe, B. D.
 76-001068
 Glenn, C. L.
 76-001097
 Gold, J. R.
 76-000928
 Golubev, S. N.
 76-000995
 Gordon, D. C., Jr.
 76-001172
 Gorelova, T. A.
 76-001080
 Green, J. M.
 76-001031
 Greenwood, P. H.
 76-001144
 Grinstead, B. G.
 76-001241
 Groderius, S. J.
 76-001189
 Groves, D. L.
 76-001217
 Guest, W. C.
 76-000929
 76-000986
 Guseva, T. V.
 76-001033
 Hackney, P. A.
 76-001278
 Hager, R.
 76-000921
 Hamilton, R. W.
 76-001155
 Hansen, D. J.
 76-001202
 76-001203
 Hara, T. J.
 76-001190
 Harache, Y.
 76-000939
 Harada, T.
 76-001162
 Hargrave, B. T.
 76-001167
 Hauser, W. J.
 76-000987
 Heidinger, R. C.
 76-001034
 Hendricks, A. C.
 76-000961

AUTHOR INDEX

Hewitt, G. C.
 76-001159
 Hickey, C. R., Jr.
 76-000988
 76-001109
 76-001110
 76-001111
 Higgs, D. A.
 76-000989
 Hill, D. M.
 76-001168
 Hill, T. K.
 76-000930
 Hine, P. M.
 76-001153
 Hirsch, N.
 76-001193
 Hitt, V. G.
 76-001024
 Hobson, E. S.
 76-001081
 Hobson, L. A.
 76-000962
 Hocutt, C. H.
 76-001107
 76-001124
 Hoese, D. F.
 76-001139
 Hoff, J. G.
 76-001079
 Holbrook, J. A. II
 76-001218
 76-001286
 Holcombe, G. W.
 76-001191
 Holder, D. R.
 76-001032
 76-001040
 Holzapfel, E. P.
 76-001294
 Hooper, A. D.
 76-001279
 Hooper, G. R.
 76-001281
 Houde, E. D.
 76-001112
 Hourston, A. S.
 76-001056
 Houser, A.
 76-001047
 76-001133
 Hubbs, C.
 76-001035
 Hunn, J. B.
 76-000990
 Hunt, R. L.
 76-000968
 76-001225
 Hurlbert, S. H.
 76-001169
 Hurst, H.
 76-001035
 Il'yasova, Z. Ya.
 76-001022
 Inada, T.
 76-000967
 Inslee, T. D.
 76-000931
 James, G. D.
 76-000991
 76-001098
 Janssen, J.
 76-001082
 Jaspers, E. J.
 76-000969
 Jenkins, R. E.
 76-001113
 Jenkins, R. M.
 76-001287
 Jensen, A. C.
 76-001219
 Johnson, G. W.
 76-001256
 Johnson, H. E.
 76-001213
 Jones, J. B.
 76-000917
 Keefe, T. J.
 76-001262
 Keith, W. E.
 76-001288
 Kelso, J. R. M.
 76-001070
 Kerr, S. R.
 76-001263
 Khalifa, K. A.
 76-001151
 76-001160
 Kikuchi, W. K.
 76-000916
 Kilambi, E. V.
 76-000936
 Kimball, G. L.
 76-001205
 King, C. L.
 76-001013
 Kjelson, M. A.
 76-001256
 Kleerekoper, H.
 76-001192
 Klyashtorin, L. B.
 76-000992
 Knopf, R. C.
 76-001229

AUTHOR INDEX

Koenig, C. C.

76-000993

Kogan, A. V.

76-001083

Komarov, I. P.

76-000994

Komarov, P. V.

76-000994

Korn, S.

76-001193

Korovina, V. M.

76-000970

Kou, G.-H.

76-001156

Kovalev, S. M.

76-001055

Kovalevskaya, N. V.

76-000971

Kowarsky, J.

76-001114

Kratt, L. F.

76-001164

Kriksunov, E. A.

76-001264

Krogus, F. V.

76-001048

Kucherova, F. M.

76-000995

Kutuzov, A. M.

76-001057

Kyazimov, I. B.

76-000919

Lackey, R. T.

76-001215

76-001220

76-001266

Lahav, M.

76-000981

Langford, F.

76-000938

Larimore, R. W.

76-001129

Larsen, D. P.

76-000958

Larson, H. K.

76-001140

Lasker, R.

76-001267

Latta, W. C.

76-001269

Lauris, R. M.

76-001243

Law, D. K.

76-000953

Law, Y. M. C.

76-001190

Leahy, J. R.

76-001176

Leaman, B. M.

76-001244

Lebedev, V. G.

76-001099

Lech, J. J.

76-001208

Lee, D. S.

76-001115

Leggett, W. C.

76-001068

Lehner, C. E.

76-001065

Lemanova, N. A.

76-001261

Lenarz, W. H.

76-001243

Leonard, E. M.

76-001191

Lester, J. W.

76-001111

Lester, T. E.

76-001109

Letichevskiy, M. A.

76-001049

Levy, E. M.

76-000957

Lewis, J. R.

76-001181

Lewis, M.

76-001194

Lewis, W. M.

76-000932

Li, H. W.

76-001251

Lindenberg, J. G.

76-001071

Livingston, R. J.

76-000993

Loesch, H. C.

76-001021

Loewen, B.

76-001110

Loftus, K. H.

76-001221

Lorz, H. W.

76-001195

Lovell, R. T.

76-000943

76-000944

Loyacano, H. A., Jr.

76-000945

76-001284

Luedtke, R. J.

76-000960

AUTHOR INDEX

Lundstrom, R. C.

76-001296

Lyagina, T. N.

76-001058

MacCrimmon, H. R.

76-000952

76-001116

Macdonald, S.

76-001190

MacFarlane, L. R.

76-000946

Magonedov, S. K.

76-000980

Mahnken, C.

76-000951

Makarova, N. P.

76-001059

Makeyeva, A. P.

76-000975

Maki, A. W.

76-001213

Manzer, J. I.

76-001084

Marking, L. L.

76-000954

76-001179

Marusov, Ye. A.

76-000996

Masnik, M. T.

76-001124

Mathews, S. B.

76-000920

76-001130

McAllister, R.

76-001231

McBride, J. R.

76-000989

McCall, T. D.

76-001227

McDannold, W. E.

76-001237

McDowell, R. M.

76-001117

McKee, T. B.

76-000953

McKim, J. M.

76-001191

McPherson, B. P.

76-001195

McSwain, L. E.

76-001032

76-001040

Mears, H. C.

76-001245

Meier, A. H.

76-001021

Melancon, M. J., Jr.

76-001208

Mercier, H. T.

76-000958

Merkowsky, A.

76-000933

Merriner, J. V.

76-001257

Messiah, S. M.

76-001060

Meyer, H. L.

76-001257

Mezhnin, F. I.

76-000997

Miles, D. L.

76-001175

Miller, R. J.

76-001036

Milstein, C. B.

76-001118

Minckley, C. O.

76-001085

Ming, A.

76-001237

Mires, D.

76-000934

Mitchell, D. F.

76-001093

Mitenev, V. K.

76-001149

Mock, J. B.

76-000920

Moffatt, J. D.

76-000957

Moiseyeva, Ye. B.

76-000972

Moller, P.

76-001017

Montgomery, W. L.

76-001145

Moody, H. L.

76-001232

Moriarty, D. J. W.

76-001086

Morris, W. J.

76-000962

Moyle, P. B.

76-001251

Muller, R.

76-001018

Nagel, T.

76-000947

Nail, M. L.

76-001280

Neal, M. W.

76-001263

AUTHOR INDEX

Nebeker, A. V.

76-001161

Nelson, E. M.

76-000973

Nishimoto, R. N.

76-001243

Nishimura, H.

76-001297

Norden, A.

76-001115

Norton, V. M.

76-001297

Novinger, G. D.

76-001248

Novotny, A. J.

76-000939

Nusenbaum, L. M.

76-001261

Oatis, P. H.

76-001290

Ogle, D. G.

76-001276

O'Grady, K. T.

76-001175

Oishi, K.

76-001162

Oseid, D. M.

76-001204

76-001205

Ots, J-P.

76-001037

Page, L. M.

76-001038

76-001141

Panasenko, V. A.

76-001061

Pantelouris, E. M.

76-001009

76-001010

Paragamian, V. L.

76-001087

Pardo, R. J.

76-000998

Parrack, M. L.

76-001233

Parrish, P. R.

76-001196

76-001202

Pasch, R. W.

76-001088

Patrick, J. M., Jr.

76-001196

76-001202

Paulson, L. J.

76-001085

Pavlovskaya, R. M.

76-001131

Pentreath, R. J.

76-001197

Pepper, V. A.

76-001031

Perkins, C. J.

76-001211

Perlmutter, A.

76-001201

Perry, W. G.

76-001062

Pertseva-Ostroumova, T.

76-001142

Peterson, M. L.

76-001298

Peterson, R. H.

76-001198

Pflieger, W. L.

76-001132

76-001273

Phillips, G. A.

76-001167

Piper, R. G.

76-000954

Pipkin, R. E.

76-000928

Pirquet, K. T.

76-000962

Plumb, J. A.

76-001289

Ponomareva, V. P.

76-000972

Post, G.

76-001151

76-001160

Poston, H. A.

76-000948

76-000949

Powell, D. H.

76-001270

76-001280

Powers, J. E.

76-001220

Prather, E. E.

76-000943

Prentice, J. A.

76-001100

Primmer, K. W.

76-001170

Prince, E. D.

76-001226

Puttmann, S. J.

76-000942

Rainwater, W. C.

76-001047

AUTHOR INDEX

Rainwater, W. C.....continued
 76-001133
 Raleigh, R. F.
 76-001226
 Ramsey, J. S.
 76-001143
 Raney, E. C.
 76-001107
 Ravesi, E. M.
 76-001296
 Raymond, H. L.
 76-001157
 76-001260
 Reed, J. E., Jr.
 76-001124
 Reeves, R. D.
 76-001181
 Reeves, W. C.
 76-000924
 76-001102
 Reich, K.
 76-001271
 Revelle, L. A.
 76-001113
 Reynolds, W. W.
 76-001019
 76-001020
 Ricker, W. E.
 76-001293
 Rickett, J. D.
 76-000935
 Rideout, S. G.
 76-001290
 Robbins, W. H.
 76-001116
 Roberts, P. E.
 76-001119
 Robertson, D. A.
 76-001039
 76-001117
 76-001120
 76-001121
 Romero, J.
 76-001051
 Roseberg, R. B.
 76-000936
 Rosen, D. E.
 76-001144
 Rosenberg, D. M.
 76-001199
 Rosenblatt, R. H.
 76-001145
 Rosenthal, H.
 76-001056
 76-001094
 76-001200

Rottman, R. W.....continued
 76-001152
 Roussel, J. D.
 76-000929
 76-000969
 76-000986
 Rowell, D. M.
 76-000979
 Rusaouen, M.
 76-000999
 Sabins, D. S.
 76-001072
 Saila, S. B.
 76-001265
 Saito, R.
 76-001117
 Sakagawa, G. T.
 76-001294
 Sandow, J. T., Jr.
 76-001040
 Santerre, M. T.
 76-001000
 Sarot, D. A.
 76-001201
 Saylor, C. F.
 76-001168
 Schimmel, S. C.
 76-001202
 76-001203
 Schreck, C. B.
 76-000914
 Sedletskaya, V. A.
 76-001063
 Seidensticker, E. P.
 76-001222
 76-001291
 Senn, H.
 76-000920
 Senn, H. G.
 76-000921
 Seshagiri Rao, B. V.
 76-001146
 Sharipov, K. O.
 76-001001
 Shcherbina, M. A.
 76-000950
 Shen, S.-C.
 76-001147
 Shepel', L. I.
 76-001043
 Sherstnyeva, T. A.
 76-001002
 Shertzer, E.
 76-001180
 Shireman, J. V.
 76-001152

AUTHOR INDEX

Shortreed, K. R. S.

76-000963
Shpak, V. M.
76-001011
Shub, C.
76-000983
Shubnikova, N. G.
76-000975
Sidorin, A. P.
76-001264
Siler, J. R.
76-001171
Simco, B. A.
76-000982
Sirikul, B.
76-000944
Skillman, R. A.
76-001101
Skud, B. E.
76-001295
Slatick, E.
76-001246
Smith, A. O.
76-001286
Smith, B. W.
76-001281
Smith, L. L., Jr.
76-001135
76-001177
76-001178
76-001189
76-001204
76-001205
Smith, M. H.
76-001013
Smith, P. W.
76-001105
76-001141
Smith, R. J. F.
76-001164
Smith, W. E.
76-001089
Smitherman, R. O.
76-001282
Snow, J. R.
76-000937
76-001283
Sokolovskaya, T. S.
76-001122
Sokolovskiy, A. S.
76-001122
76-001123
Somkina, N. V.
76-001003
Spataru, P.
76-001090

Spehar, R. L.

76-001206
Spieler, R. E.
76-001021
Spinelli, J.
76-000951
Sprague, J. B.
76-001207
Sreedharan, A.
76-000959
Stanley, J. G.
76-000917
76-001064
Statcham, C. N.
76-001208
Stauffer, J. R.
76-001107
Stauffer, J. R., Jr.
76-001124
Stevens, D. G.
76-001161
Stevens, R. E.
76-000925
76-001223
Stich, H. F.
76-001163
76-001187
Stickney, R. R.
76-001258
Stockner, J. G.
76-000963
Stolbov, A. Ya.
76-001004
Strange, R. J.
76-000914
Stroganov, N. S.
76-001184
Struhsaker, J. W.
76-001193
Sullivan, J. R.
76-001150
Summerfelt, R. C.
76-001069
76-001134
Sutherland, A. J.
76-001276
Sutton, R. J.
76-001125
Swanson, C. D.
76-001032
Swenson, W. A.
76-001135
Sytina, L. A.
76-001005
Taylor, E. A.
76-001168

AUTHOR INDEX

Teal, J. M.	Walker, C. E.
76-001092	76-001174
Tennant, D. L.	Ware, F. J.
76-001277	76-000926
Terrell, J. W.	Warner, K.
76-000915	76-001238
76-001091	Watson, J. W., Jr.
Theisen, B.	76-001259
76-001006	Webb, J. F.
Thomas, D. L.	76-001102
76-001118	Webster, D. A.
Thomaston, W. W.	76-001066
76-001240	76-001249
Thomson, D. A.	Wegener, W.
76-001065	76-001227
Tiemier, O. W.	76-001292
76-000941	Wehr, L. W.
Tres-Dick, J.	76-000932
76-000943	Weinstein, M. P.
Truesdale, F. M.	76-001148
76-001072	Welch, H. E.
Tsai, C.	76-000959
76-001188	Wells, J.
Tsokur, A. G.	76-001028
76-000974	Westgate, J. W.
Tsuneki, K.	76-000953
76-001007	White, C. E., Jr.
Twongo, T. K.	76-001281
76-000952	Whiteside, B. G.
U.S. Department of Commerce	76-001100
76-001224	Wickham, D. A.
Valiela, I.	76-001259
76-001092	Wiens, A. P.
Vandermeulen, J. H.	76-001199
76-001172	Wilbur, R. L.
Vaughan, D. S.	76-000938
76-001265	Williams, I. V.
Vechkanov, V. S.	76-001154
76-001008	Williams, V.
Verigin, B. V.	76-001227
76-000975	76-001292
Vince, S.	Willson, K.
76-001092	76-000920
Vogele, L. E.	Winner, R. W.
76-001041	76-001209
von Geldern, C., Jr.	Winters, G. H.
76-001093	76-001050
von Westerhagen, H.	Wissing, T. E.
76-001094	76-001103
Vooren, C. M.	Wobeser, G.
76-001042	76-001164
Wagner, P. J.	Woodward, D. F.
76-001067	76-001210
Waldichuk, M. (ed.)	Woodward, R. L.
76-001173	76-001103

AUTHOR INDEX

Yamazaki, F.
76-001162
Yerger, R. W.
76-001148
Yong, M. Y. Y.
76-001101
Young, B. H.
76-001111
Zilanzov, V. K.
76-001043
Zinck, M. E.
76-001176
Zorach, T.
76-001113
Zorn, M.
76-001090
Zubchenko, A. V.
76-001149
Zuboy, J. R.
76-001220
76-001266
Zweifel, J. R.
76-001267

GEOGRAPHIC INDEX

Alabama
 76-001270
 76-001279
 76-001281
 76-001282
 76-001283
 Alabama: Barbour Cty.
 Public Fishing Lake
 76-001280
 Alabama: Lewis Smith
 Reservoir
 76-001102
 Alaska
 76-001253
 Alaska: Chandalar River
 76-001028
 Arctic Ocean: Barents Sea
 76-001055
 Arizona: Lake Mead
 76-001085
 Arkansas
 76-001047
 76-001133
 Arkansas: Bull Shoals Lake
 76-001126
 Atlantic Ocean
 76-001009
 76-001010
 76-001060
 Atlantic Ocean: Canada
 76-001137
 Atlantic Ocean: Canada:
 Newfoundland
 76-001025
 Atlantic Ocean, Central-
 Eastern
 76-001063
 Atlantic Ocean, Eastern
 Tropical
 76-001294
 Atlantic Ocean: Gulf of St.
 Lawrence
 76-001050
 Atlantic Ocean: New Jersey
 76-001118
 Atlantic Ocean: New York
 76-001109
 76-001110
 76-001111
 Atlantic Ocean, North
 76-001043
 76-001233
 Atlantic Ocean: North
 Carolina
 76-001044
 76-001045
 Atlantic Ocean, Northwest
 76-001031
 Atlantic Ocean: Nova Scotia
 76-001167
 Atlantic Ocean, Southern
 76-001108
 Atlantic Ocean, Western
 North
 76-001136
 Australia: Pacific Ocean
 76-001114
 Bering Sea
 76-001138
 Black Sea
 76-001001
 76-001078
 76-001131
 California: Clear Lake
 76-001251
 California: Lake Havasu
 76-001093
 California, Pacific Ocean
 76-001073
 76-001081
 76-001231
 Canada: Atlantic Ocean
 76-001137
 Canada: British Columbia
 76-001056
 Canada: British Columbia:
 Chilko Lake
 76-001154
 Canada: British Columbia:
 Great Central Lake
 76-001084
 Canada: British Columbia:
 Vancouver Island
 76-000963
 Canada: Gulf of St. Lawrence
 76-001050
 Canada: Manitoba:
 Assiniboine River
 76-001097
 Canada: Manitoba: West Blue
 Lake
 76-001070
 Canada: Maritime Provinces
 76-001060
 Canada: New Brunswick: St.
 John River
 76-001068
 Canada: Newfoundland:
 Atlantic Ocean
 76-001025

GEOGRAPHIC INDEX

Canada: Northwest
Territories: Trail River
76-001199
Canada: Nova Scotia:
Chedabucto Bay
76-001172
Canada: Nova Scotia: St.
Margaret's Bay
76-001167
Canada: Ontario
76-001250
Canada: Ontario Lakes
76-000959
Caspian Sea
76-001033
76-001049
Central America
76-001144
Chesapeake Bay
76-000956
Chile: Pacific Ocean
76-001139
Colorado
76-001125
Colorado: Boulder Cty.
76-001052
Delaware
76-001115
Florida
76-001024
76-001026
76-001254
Florida: Lake Tohopekaliga
76-001227
76-001292
Florida: St. Johns River
76-001232
France
76-000939
Georgia
76-000915
76-001091
76-001171
76-001211
Georgia: Farm Ponds
76-001240
Georgia: Lake Blackshear
76-001088
Georgia: Lake Seminole
76-001289
Georgia: Lumpkin Cty.:
Waters Creek
76-001235
Georgia: Okefenokee Swamp
76-001032

Georgia: Ossabaw Sound
76-001258
Georgia: Satilla River
76-001040
Georgia: Suches
76-001170
Georgia: Suwannee River
76-001032
Guam: Pacific Ocean
76-001140
Gulf of Mexico
76-001112
76-001148
Hawaii
76-000916
Hawaii, Pacific Ocean
76-001067
Idaho: Emerald Creed
76-000960
Idaho: Snake River
76-001260
Illinois
76-001104
Illinois: Big Creek
76-001038
Indian Ocean: Gulf of Aden
76-001029
Indian Ocean: Kathiawar
Peninsula
76-001095
Israel
76-000934
76-000981
Israel: Lake Kinneret
76-001090
76-001271
Japan: Coastal
76-001162
Lake Michigan
76-001082
Louisiana
76-001072
Louisiana: Rockefeller
Wildlife Refuge
76-001062
Maryland
76-001115
Massachusetts: Congamond
Lake
76-001071
Massachusetts: Quabbin
Reservoir
76-001290
Massachusetts: Slocum River
Estuary
76-001079

GEOGRAPHIC INDEX

Mexico

76-000965
 Mexico: Gulf of California
 76-001065
 Michigan: Gogebic Cty
 76-001234
 Minnesota: Lake of the Woods
 76-001135
 Missouri
 76-001047
 76-001133
 Missouri: Bull Shoals Lake
 76-001126
 Missouri: Courtois Creek
 76-001046
 76-001132
 76-001230
 76-001273
 76-001274
 Missouri: Pony Express Lake
 76-001237
 Nevada: Lake Mead
 76-001051
 New Jersey: Atlantic Ocean
 76-001118
 New York
 76-001249
 New York: Atlantic Ocean
 76-001109
 76-001110
 76-001111
 New York: Oneida Lake
 76-001127
 New Zealand
 76-000955
 76-001076
 76-001153
 New Zealand: Ashley River
 76-001276
 New Zealand: Burlings Stream
 76-001037
 New Zealand, Coastal
 76-000967
 76-000991
 76-001039
 76-001042
 76-001096
 76-001098
 76-001117
 76-001119
 76-001120
 76-001121
 76-001159
 New Zealand: Glentui River
 76-001074
 76-001075

New Zealand: Hauraki Gulf

76-001030
 New Zealand: North Island
 76-001181
 New Zealand: Pacific Ocean
 76-001011
 New Zealand: Woolly Creek
 76-001255
 North America
 76-001116
 76-001293
 North Carolina: Brevard
 76-001170
 North Carolina, Coastal
 76-001044
 76-001045
 Ohio: Four Mile Creek
 76-001103
 Oklahoma: Arbuckle Reservoir
 76-001069
 Oklahoma: Eufaula Reservoir
 76-001069
 Oklahoma: Lake Carl
 Blackwell
 76-001134
 Oklahoma: McCurtain Cty.:
 Mountain Fork River
 76-001228
 Pacific Ocean
 76-001295
 Pacific Ocean: Australia
 76-001114
 Pacific Ocean: British
 Columbia
 76-001056
 Pacific Ocean: California
 76-001231
 Pacific Ocean, California
 Coast
 76-001081
 Pacific Ocean: California
 Current
 76-001073
 Pacific Ocean: Chile
 76-001139
 Pacific Ocean, Eastern
 Tropical
 76-001145
 Pacific Ocean: Guam
 76-001140
 Pacific Ocean: Gulf of
 California
 76-001065
 Pacific Ocean: Hawaii
 76-001067

GEOGRAPHIC INDEX

Pacific Ocean, Indo-West

76-001077

76-001146

Pacific Ocean: Japan

76-001162

Pacific Ocean: New Zealand

76-000967

76-000991

76-001011

76-001039

76-001042

76-001096

76-001098

76-001117

76-001119

76-001120

76-001121

76-001159

Pacific Ocean: New Zealand:

Hauraki Gulf

76-001030

Pacific Ocean, North

76-001243

Pacific Ocean, North Central

76-001101

Pacific Ocean, Northern

76-001138

Pacific Ocean, Northwestern

76-001122

Pacific Ocean: Philippine Sea

76-001123

Pacific Ocean: Puget Sound

76-001130

Pacific Ocean: Taiwan

76-001147

Pacific Ocean, Western

76-001142

Pennsylvania: Susquehanna River

76-001054

South America

76-001144

South Carolina: Lake Keowee

76-001284

South Carolina: Walhalla

76-001170

Taiwan

76-001156

Taiwan: Pacific Ocean

76-001147

Tennessee: Norris Reservoir

76-001286

Tennessee: North Fork

Holston River

76-001168

Texas

76-001222

Texas, Central

76-001100

Texas: Sam Rayburn Lake

76-001291

Texas: Toledo Bend Lake

76-001291

United States: Atchafalaya River

76-001106

United States: Lower Mississippi Basin

76-001106

United States: Midwest

76-001105

United States, Reservoirs

76-001287

USSR

76-001022

76-001099

USSR: Barents Sea

76-001055

USSR: Caspian Sea

76-001049

USSR: Kola Peninsula

76-001149

USSR: Kura River

76-000919

76-001023

USSR: Kursha Bay

76-001061

USSR: Kuybyshev Reservoir

76-001053

USSR: Kuybyshevskoe Reservoir

76-001057

76-001083

USSR: Lake Dal'neye

76-001048

USSR: Pskovsko-Chudskoe Lake

76-001264

USSR: Uglich Reservoir

76-001059

USSR: Volga River

76-001261

USSR: Volga River Delta

76-000994

Virginia: East River

76-001124

Virginia: North Fork Holston River

76-001168

Virginia: Smith Mountain Lake

76-000961

Virginia, Southeastern

76-001113

GEOGRAPHIC INDEX

Washington

76-000918

76-001252

Washington: Columbia River

76-001157

Washington: Puget Sound

76-001130

Washington: Snake River

76-001157

76-001246

West Virginia

76-001107

West Virginia: East River

76-001124

Wisconsin: Lawrence Creek

76-001225

SPECIES INDEX

- Abramis brama - Blood Chemistry
76-000994
- Abramis brama - Spawning
76-001053
76-001061
- Acerina cernua - Antiseptics
76-001184
- Acipenser guldenstadti - Salinity
76-001003
- Acipenseridae - Early Development
76-001005
- Adinia xenica - Embryology
76-000993
- Allothunnus fallai - Distribution/Geographical
76-001119
- Alosa pseudoharengus - Distribution/Vertical
76-001071
- Alosa pseudoharengus - Foods/Feeding/Selectivity
76-001082
- Alosa sapidissima - Movements
76-001068
- Anguilla anguilla - Variation Studies
76-001009
76-001010
- Anguilla - Eimeria anguillae
76-001153
- Anguilla - Parasites/Diseases
76-001153
- Anguilla - Protozoan Diseases
76-001153
- Anguilla rostrata - Variation Studies
76-001009
76-001010
- Anomalopidae - Evolution
76-001145
- Anomalopidae - New Species
76-001145
- Aphanopus carbo - Life History/General
76-001043
- Arius thalassinus - Age/Growth
76-001095
- Arius thalassinus - Age/Length Composition
76-001095
- Arripis trutta - Age/Growth
76-001096
- Aspius aspius - Blood Chemistry
76-000994
- Blicca bjoerkna - Blood Chemistry
76-000994
- Blicca bjoerkna - Spawning
76-001057
- Brachydanio rerio - Bacterial Diseases
76-001201
- Brachydanio rerio - Heavy Metals
76-001201
- Brachydanio rerio - Parasites/Diseases
76-001201
- Brachydanio rerio - Viral Diseases
76-001201
- Brachydanio rerio - Zinc
76-001201
- Brevoortia tyrannus - Foods/Feeding/Selectivity
76-001079
- Compostoma anomalum - Distribution/Geographical
76-001104
- Compostoma oligolepis - Distribution/Geographical
76-001105
- Compostoma oligolepis - Taxonomy
76-001105
- Compostoma ornatum - Distribution/Geographical
76-000965
- Compostoma ornatum - Morphology
76-000965
- Compostoma ornatum - Taxonomy
76-000965
- Caranx georgianus - Early Development
76-000991
- Caranx georgianus - Embryology
76-000991
- Caranx mate - Salinity
76-001000
- Caranx mate - Temperature
76-001000

SPECIES INDEX

- Carapidae. - Distribution/Geographical
 76-001121
 Carassius auratus - Chromium
 76-001178
 Carassius auratus - Guthion
 76-001178
 Carassius auratus -
 Hydrogen Sulfide
 76-001204
 Carassius auratus -
 Insecticides
 76-001178
 Carassius auratus -
 Pentachlorophenol
 76-001178
 Carassius auratus -
 Research Test Fish
 76-001178
 Carassius auratus - Sodium
 Chloride
 76-001178
 Carpiodes cyprinus -
 Age/Growth
 76-001103
 Carpiodes cyprinus -
 Fecundity
 76-001103
 Carpiodes velifer -
 Age/Growth
 76-001103
 Carpiodes velifer -
 Fecundity
 76-001103
 Caspialosa kessleri - Fish
 Lifts
 76-001261
 Caspialosa kessleri -
 Spawning
 76-001261
 Catostomus commersoni -
 Hydrogen Sulfide
 76-001204
 Catostomus commersoni -
 Lernaea cyprinacea
 76-001160
 Catostomus commersoni -
 Parasites/Diseases
 76-001160
 Catostomus commersoni -
 Parasitic Copepods
 76-001160
 Chalcalburnus chalcoides -
 Life History/General
 76-001023
 Cheilodactylus macropterus -
 Age/Growth
 76-001042
 Cheilodactylus macropterus
 - Distri
 bution/Geographical
 76-001042
 Cheilodactylus macropterus -
 Early Development
 76-001042
 Cheilopogon intermedius -
 Early Development
 76-000971
 Chelidonichthys kumu -
 Age/Growth
 76-001030
 Chelidonichthys kumu -
 Population Studies
 76-001030
 Chelidonichthys kumu -
 Spawning
 76-001030
 Clupea harengus harengus -
 Abundance/Factors of
 76-001050
 Clupea harengus harengus -
 Fecundity
 76-001060
 Clupea harengus harengus -
 Management/
 Research/Marine
 76-001050
 Clupea harengus harengus -
 Recruitment
 76-001050
 Clupea harengus pallasi -
 Predator/Prey
 Relationships
 76-001094
 Clupea harengus pallasi -
 Reproduction
 76-001056
 Clupea harengus pallasi -
 Spawning
 76-001056
 Clupeonella deliculata -
 Foods/Feeding/Selectivity
 76-001083
 Cnidoglanis macrocephalus -
 Distribution/Geographical
 76-001114
 Cnidoglanis macrocephalus -
 Taxonomy
 76-001114
 Cobitis taenia - Antiseptics
 76-001184
 Conger verreauxi -
 Congericola kabatai
 76-001159

Conger verreauxi -
 Parasites/Diseases
 76-001159
Conger verreauxi -
 Parasitic Copepods
 76-001159
Coregonus autumnalis
 migratorius - Olfaction
 76-000966
Coregonus lavaretus
 nelmuschka - Age/Growth
 76-001099
Coregonus lavaretus
 nelmuschka - Morphology
 76-001099
Coregonus lavaretus -
 Parasites/Diseases
 76-001149
Cottus cognatus - Life
 History/General
 76-001028
Ctenopharyngodon idella -
 Age/Growth
 76-001091
Ctenopharyngodon idella -
 Aquatic Plant Control
 76-000915
Ctenopharyngodon idella -
 Bacterial Diseases
 76-001152
Ctenopharyngodon idella -
 Catchability
 76-001091
Ctenopharyngodon idella -
 Chondrococcus columnaris
 76-001152
Ctenopharyngodon idella -
 Columnaris Disease
 76-001152
Ctenopharyngodon idella -
 Foods/Feeding
 76-001091
Ctenopharyngodon idella -
 Parasites/Diseases
 76-001152
Ctenopharyngodon idella -
 Spawning
 76-001064
Ctenopharyngodon idella X
 Aristichthys nobilis
 76-000975
Ctenopharyngodon idella X
 Cyprinus carpio -
 Culture/Propagation
 76-000933

Cynoscion - Taxonomy

76-001148
Cyprinodon variegatus -
 Endrin
 76-001202
Cyprinodon variegatus -
 Fungicides
 76-001196
Cyprinodon variegatus -
 Hexachlorobenzene
 76-001196
Cyprinodon variegatus -
 Insecticides
 76-001202
Cyprinodon variegatus -
 Research Test Fish
 76-001203
Cyprinus carpio -
 Culture/Propagation
 76-000934
Cyprinus carpio -
 Endocrinology
 76-000977
Cyprinus carpio -
 Fingerling Production
 76-000934
Cyprinus carpio - Metabolism
 76-001002
Cyprinus carpio -
 Parasites/Diseases
 76-001156
Cyprinus carpio - Tumors
 76-001156
Diaphus agassizi -
 Identification
 76-001142
Diaphus malayanus - Early
 Development
 76-000974
Diplophos rebaini -
 Distribution/Geographical
 76-001120
Diplophos rebaini -
 Distribution/Seasonal
 76-001120
Diplophos rebaini - Early
 Development
 76-001120
Dorosoma cepedianum -
 Distribution/Geographical
 76-001109
Dorosoma petenense -
 Foods/Feeding
 76-001093
Dorosoma petenense -
 Management/
 Research/Reservoirs
 76-001093

Dorosoma petenense -
 Predator
 /Prey/Relationships
 76-001093
Echiodon rendahli -
 Distribution/Geographical
 76-001121
Echiodon rendahli -
 Morphology
 76-001121
Engraulis encrasicolus
 ponticus -
 Abundance/Factors of
 76-001131
Engraulis mordax - Benzene
 76-001193
Engraulis mordax -
 Foods/Feeding/Selectivity
 76-001073
Engraulis mordax - Oil
 76-001193
Enneacanthus chaetodon -
 Distribution/Geographical
 76-001113
Eptatretus burgeri -
 Endocrinology
 76-001007
Eptatretus deani - Olfaction
 76-001006
Eptatretus stoutii -
 Olfaction
 76-001006
Esox lucius - Antiseptics
 76-001184
Esox lucius - Respiration
 76-000984
Etheostoma kennicotti -
 Life History/General
 76-001038
Etheostoma kennicotti -
 Taxonomy
 76-001141
Eviota pellucidus - New
 Species
 76-001140
Fundulus grandis -
 Photoperiodism
 76-001021
Fundulus grandis - Salinity
 76-001021
Fundulus heteroclitus -
 Foods/Feeding
 76-001092
Fundulus heteroclitus -
 Predator/Prey
 Relationships

Fundulus heteroclitus...cont
 76-001092
Galaxias fasciatus - Life
 History/General
 76-001037
Galaxias fasciatus -
 Spawning
 76-001037
Galaxias maculatus -
 Distribution/Geographical
 76-001117
Galaxias maculatus - Early
 Development
 76-001117
Galaxias maculatus -
 Movements
 76-001117
Galaxias vulgaris -
 Activity Patterns
 76-001076
Galaxias vulgaris -
 Foods/Feeding
 76-001075
 76-001076
Galaxias vulgaris -
 Foods/Feeding/Selectivity
 76-001074
Gasterosteus aculeatus -
 Foods/Feeding
 76-001084
Gasterosteus aculeatus -
 Habitat Selection
 76-001084
Gila cypla -
 Distribution/Geographical
 76-001125
Glyptocephalus cynoglossus -
 Age/Growth
 76-001025
Glyptocephalus cynoglossus -
 Maturity
 76-001025
Glyptocephalus cynoglossus -
 Vertical Distribution
 76-001025
Gobiidae - New Genus
 76-001139
Gobiidae - New Species
 76-001140
Gobio gobio - Antiseptics
 76-001184
Gobius batrachocephalus -
 Reproductive System
 76-000972
Gobius melanostomus -
 Reproductive System
 76-000972

SPECIES INDEX

- Harriotta raleighana* -
 Morphology
 76-000967
Hiodon tergisus - Age/Growth
 76-001097
Hippoglossus stenolepis -
 Harvest
 76-001295
Hippoglossus stenolepis -
 Management/
 Research/Marine
 76-001295
Hypophthalmichthys molitrix
 - Reproductive System
 76-000995
Hypophthalmichthys molitrix
 - Respiration
 76-001008
Ictalurus furcatus X *I.*
 punctatus - Blood
 Chemistry
 76-000982
Ictalurus melas - Age/Growth
 76-000935
Ictalurus melas -
 Culture/Propagation
 76-000935
Ictalurus punctatus -
 Age/Growth
 76-001100
Ictalurus punctatus - Bayer
 73
 76-001179
Ictalurus punctatus -
 Blindness
 76-000987
Ictalurus punctatus - Blood
 Chemistry
 76-000982
Ictalurus punctatus - Cage
 Culture
 76-000930
 76-000932
Ictalurus punctatus -
 Culture/Propagation
 76-000929
 76-000930
 76-000932
 76-000933
 76-000941
 76-000943
 76-000944
 76-000945
Ictalurus punctatus. -
 Feeding Experiments
 76-000941
 76-000943
 76-000944
 76-000945
Ictalurus punctatus -
 Gamete Storage
 76-000929
Ictalurus punctatus -
 Piscicides
 76-001179
Ictalurus punctatus - Sex
 Determination
 76-001297
Ictalurus punctatus - Sperm
 76-000969
 76-000986
Ictalurus punctatus -
 Supplemental Feeding
 76-001280
Ictalurus punctatus -
 Temperature Selection
 76-001013
Ictalurus punctatus - TFM
 76-001179
Ictiobus cyprinellus -
 Spawning
 76-001062
Ictiobus niger - Spawning
 76-001062
Ilisha - Identification
 76-001146
Ilisha - Taxonomy
 76-001146
Jordanella floridae -
 Cadmium
 76-001206
Jordanella floridae - Heavy
 Metals
 76-001206
Jordanella floridae - Zinc
 76-001206
Katsuwonus pelamis -
 Age/Length Composition
 76-001294
Kryptophaneron harveyi -
 New Species
 76-001145
Labridae -
 Distribution/Geographical
 76-001147
Labridae - Foods/Feeding
 76-001078
Labridae - Identification
 76-001147

SPECIES INDEX

- Lagodon rhomboides* - Fungicides
 76-001196
Lagodon rhomboides -
 Habitat Selection
 76-001045
Lagodon rhomboides -
 Hexachlorobenzene
 76-001196
Lagodon rhomboides -
 Production
 76-001044
Lepomis auritus - Life
 History/General
 76-001024
 76-001040
Lepomis cyanellus - Larvae
 cyprinacea
 76-001160
Lepomis cyanellus -
 Parasites/Diseases
 76-001160
Lepomis cyanellus -
 Parasitic Copepods
 76-001160
Lepomis gibbosus -
 Reproduction
 76-000978
Lepomis gulosus - Life
 History/General
 76-001032
Lepomis macrochirus -
 Activity Patterns
 76-001020
Lepomis macrochirus - Bayer
 73
 76-001179
Lepomis macrochirus -
 Digestion Rates
 76-000985
Lepomis macrochirus - Early
 Development
 76-001089
Lepomis macrochirus -
 Foods/Feeding
 76-000985
 76-001089
Lepomis macrochirus -
 Helminths
 76-001158
Lepomis Macrochirus -
 Hydrogen Sulfide
 76-001204
 76-001205
Lepomis macrochirus -
Leptorhynchoides thecatus
 76-001158
Lepomis macrochirus -
 Modeling
 76-001266
Lepomis macrochirus -
 Parasites/Diseases
 76-001158
Lepomis macrochirus -
 Piscicides
 76-001179
Lepomis macrochirus -
Pomphorhynchus bulbocolli
 76-001158
Lepomis macrochirus -
 Spawning
 76-001052
Lepomis macrochirus -
 Supplemental Feeding
 76-001280
Lepomis macrochirus - TFM
 76-001179
Lepomis microlophus -
 Supplemental Feeding
 76-001280
Leptoclinus maculatus -
 Identification
 76-001137
Leuciscus idus - Respiration
 76-000984
Limanda schrenki -
 Parasites/Diseases
 76-001162
Limanda schrenki - Tumors
 76-001162
Liparis coheni - Life
 History/General
 76-001136
Liparis coheni - New Species
 76-001136
Lota lota - Interrenal
 Tissue
 76-000997
Lucioperca marina - Early
 Development
 76-001033
Lucioperca marina -
 Foods/Feeding
 76-001033
Lumpenus lampretaeformis -
 Identification
 76-001137
Makaira nigricans -
 Age/Growth
 76-001101
Mallotus villosus -
 Fecundity
 76-001055

SPECIES INDEX

- Marcusenius cyprinoides -Electric Organs
76-001017
- Marcusenius cyprinoides -
Schooling Behavior
76-001017
- Maurolicus muelleri -
Distribution/Geographical
76-001039
- Maurolicus muelleri - Early
Development
76-001039
- Maurolicus muelleri - Life
History/General
76-001039
- Maurolicus muelleri -
Spawning
76-001039
- Mecromesistius australis -
Taxonomy
76-001011
- Mecromesistius australis -
Variation Studies
76-001011
- Megolops atlantica -
Distribution/Geographical
76-001111
- Menidia audens - Forage
Introductions
76-001251
- Micropterus -
Abundance/Factors of
76-001128
76-001133
76-001268
76-001269
76-001275
76-001278
76-001287
- Micropterus - Artificial
Reefs
76-001226
- Micropterus - Behavior
76-001036
- Micropterus coosae - Life
History/General
76-001035
- Micropterus -
Culture/Propagation
76-000927
76-000937
- Micropterus -
Distribution/Geographical
76-001116
- Micropterus dolomieu -
Abundance/Factors of
76-001129
76-001132
- Micropterus dolomieu -
Activity Patterns
76-001019
- Micropterus dolomieu -
Culture/Propagation
76-000931
76-000942
- Micropterus dolomieu -
Feeding Experiments
76-000942
- Micropterus dolomieu -
Floods
76-001129
- Micropterus dolomieu -
Foods/Feeding/Selectivity
76-001087
- Micropterus dolomieu -
Harvest
76-001230
- Micropterus dolomieu -
Life History/General
76-001027
- Micropterus dolomieu -
Management/
Research/Reservoirs
76-001290
- Micropterus dolomieu -
Management/
Research/Rivers and
Streams
76-001230
76-001274
- Micropterus dolomieu -
Mortality Rates
76-001132
- Micropterus dolomieu -
Photoperiodism
76-001019
- Micropterus dolomieu -
Population Studies
76-001234
76-001274
76-001290
- Micropterus dolomieu -
Size Limits
76-001234
- Micropterus dolomieu -
Spawning
76-001132
- Micropterus domomieu -
Management/
Research/Rivers and
Streams
76-001046
76-001273

SPECIES INDEX

- Micropterus domomiei - Population Studies
 - 76-001046
- Micropterus - Fish
 - Control/Removal
 - 76-001239
 - 76-001241
- Micropterus - Genetics
 - 76-000927
- Micropterus - Heavy Metals
 - 76-001183
- Micropterus - Life
 - History/General
 - 76-001036
- Micropterus -
 - Management/
 - Research/General
 - 76-001216
 - 76-001220
- Micropterus -
 - Management/Research/Lakes
 - 76-001268
 - 76-001269
- Micropterus -
 - Management/Research/Ponds
 - 76-001278
 - 76-001282
- Micropterus -
 - Management/
 - Research/Reservoirs
 - 76-001133
 - 76-001286
 - 76-001287
 - 76-001288
- Micropterus -
 - Management/
 - Research/Rivers and
 - Streams
 - 76-001272
 - 76-001275
- Micropterus - Modeling
 - 76-001220
- Micropterus notius - Life
 - History/General
 - 76-001035
- Micropterus - Oxygen
 - 76-001183
- Micropterus -
 - Parasites/Diseases
 - 76-001150
- Micropterus - Pesticides
 - 76-001183
- Micropterus - Piscicides
 - 76-001239
- Micropterus - Population
 - Studies
 - 76-001268
 - 76-001269
- Micropterus - Population
 - Studies.....continued
 - 76-001272
 - 76-001275
 - 76-001278
 - 76-001287
- Micropterus punctulatus
 - henshalli - Age/Growth
 - 76-001102
- Micropterus punctulatus -
 - Life History/General
 - 76-001041
- Micropterus - Regulations
 - 76-001236
- Micropterus - Salinity
 - 76-001183
- Micropterus salmoides -
 - Abundance/Factors of
 - 76-001051
 - 76-001126
 - 76-001134
- Micropterus salmoides -
 - Activity Patterns
 - 76-001019
- Micropterus salmoides -
 - Age/Growth
 - 76-000935
 - 76-001088
 - 76-001100
- Micropterus salmoides -
 - Culture/Propagation
 - 76-000935
 - 76-000938
- Micropterus salmoides -
 - Fishing Tournaments
 - 76-001218
 - 76-001222
 - 76-001232
 - 76-001284
 - 76-001289
 - 76-001291
- Micropterus salmoides
 - floridanus - Life
 - History/General
 - 76-001026
- Micropterus salmoides
 - floridanus -
 - Management/
 - Research/General
 - 76-001026
- Micropterus salmoides -
 - Foods/Feeding
 - 76-001088
 - 76-001093
- Micropterus salmoides -
 - Harvest
 - 76-001214

SPECIES INDEX

- Micropterus salmoides- Harvest,....cont.
76-001232
- Micropterus salmoides -
Induced Maturation
76-000938
- Micropterus salmoides -
Life History/General
76-001034
- Micropterus salmoides -
Management/
Research/General
76-001214
- Micropterus salmoides -
Management/Research/Lakes
76-001126
76-001270
- Micropterus salmoides -
Management/Research/Ponds
76-001248
76-001279
76-001281
- Micropterus salmoides -
Management/
Research/Reservoirs
76-001088
76-001093
76-001290
- Micropterus salmoides -
Modeling
76-001266
- Micropterus salmoides -
Mortality Factors
76-001051
- Micropterus salmoides -
Photoperiodism
76-001019
- Micropterus salmoides -
Population Studies
76-001047
76-001214
76-001290
- Micropterus salmoides -
Predator/Prey
Relationships
76-001093
- Micropterus salmoides -
Production
76-001047
- Micropterus salmoides
salmoides - Age/Growth
76-001102
- Micropterus salmoides -
Size Limits
76-001237
- Micropterus salmoides -
Spawning
76-001051
- Micropterus salmoides -
Standing Crop
76-001047
- Micropterus salmoides -
Stocking/Introductions
76-001248
76-001270
- Micropterus salmoides -
Supplemental Feeding
76-001279
76-001280
- Micropterus salmoides -
Thanite
76-001211
- Micropterus salmoides -
Thermal Pollution
76-001171
- Micropterus salmoides -
Weather
76-001134
- Micropterus -
Stocking/Introductions
76-001282
- Micropterus - Taxonomy
76-001143
- Micropterus - Temperature
76-001014
- Micropterus treculi - Life
History/General
76-001035
- Micropterus - Trophic
Relationships
76-001268
76-001275
76-001278
- Micropterus - Turbidity
76-001183
- Micropterus - Water Level
Fluctuations
76-001183
76-001288
- Micropterus - Year Class
Strength
76-001128
- Misgurnus fossilis -
Antiseptics
76-001184
- Molidae -
Distribution/Geographical
76-001122
- Morone - Hybridization
76-000926
- Morone saxatilis - Benzene
76-001193
- Morone saxatilis -
Culture/Propagation
76-000922

SPECIES INDEX

- Morone saxatilis* - Culture/Propagation...
 76-000923 continued
 76-000924
 76-000925
 76-000940
 76-001223
Morone saxatilis - Feeding
 Experiments
 76-000940
Morone saxatilis - Hardness
 76-000924
Morone saxatilis - Induced
 Maturation
 76-000922
Morone saxatilis -
 Management/
 Research/General
 76-000925
 76-001223
Morone saxatilis - -
 Management/
 Research/Reservoirs
 76-001247
Morone saxatilis - Oil
 76-001193
Morone saxatilis - Pond
 Culture
 76-000923
Morone saxatilis - Salinity
 76-000924
Morone saxatilis -
 Stocking/Introducing
 76-001247
Mugil - Abundance/Factors of
 76-001131
Mugil cephalus -
 Foods/Feeding
 76-001086
Mullus barbatulus ponticus
 - Abundance/Factors of
 76-001131
Myctophidae - Foods/Feeding
 76-001080
Myxine circifrons -
 Olfaction
 76-001006
Myxocyprinus - Morphology
 76-000973
Nettastomidae -
 Distribution/Geographical
 76-001123
Notemigonus crysoleucas -
 Culture/Propagation
 76-000936
Notemigonus crysoleucas -
 Feeding Experiments
 76-000936
Notemigonus crysoleucas -
 Lipid Metabolism
 76-000998
Notropis spilopterus -
 Spawning Behavior
 76-001054
Notropus cornutus - Heavy
 Metals
 76-001180
Notropus cornutus - Iron
 76-001180
Oncorhynchus - Age/Growth
 76-001293
Oncorhynchus -
 Culture/Propagation
 76-000920
Oncorhynchus - Early
 Development
 76-000970
Oncorhynchus - Gas Bubble
 Disease
 76-001157
Oncorhynchus - Harvest
 76-001293
Oncorhynchus keta -
 Culture/Propagation
 76-000921
Oncorhynchus kisutch -
 Bayer 73
 76-001179
Oncorhynchus kisutch -
 Copper
 76-001195
Oncorhynchus kisutch -
 Culture/Propagation
 76-000918
 76-000939
 76-000951
Oncorhynchus kisutch -
 Endocrinology
 76-000989
Oncorhynchus kisutch -
 Feeding Experiments
 76-000951
Oncorhynchus kisutch -
 Growth Stimulants
 76-000989
Oncorhynchus kisutch -
 Heavy Metals
 76-001195
Oncorhynchus kisutch -
 Mariculture
 76-000939
Oncorhynchus kisutch -
 Minnow Traps
 76-001253

SPECIES INDEX

- Oncorhynchus kisutch - Mortality Rates
76-001130
- Oncorhynchus kisutch -
Piscicides
76-001179
- Oncorhynchus kisutch - TFM
76-001179
- Oncorhynchus kisutch - Zinc
76-001195
- Oncorhynchus -
Management/
Research/General
76-001221
- Oncorhynchus -
Management/
Research/Marine
76-001293
- Oncorhynchus - Mortality
Rates
76-001293
- Oncorhynchus nerka -
Age/Growth
76-001048
- Oncorhynchus nerka -
Ergasilus
76-001155
- Oncorhynchus nerka - Gas
Bubble Disease
76-001161
- Oncorhynchus nerka - IHN
76-001154
- Oncorhynchus nerka - Life
History/General
76-001048
- Oncorhynchus nerka -
Parasites/Diseases
76-001154
76-001155
76-001161
- Oncorhynchus nerka -
Parasitic Copepods
76-001155
- Oncorhynchus nerka -
Population Studies
76-001048
- Oncorhynchus nerka - Viral
Diseases
76-001154
- Oncorhynchus - Net-Pen
Culture
76-000920
- Oncorhynchus - Ocean
Ranching
76-000920
- Oncorhynchus -
Parasites/Diseases
76-001157
- Oncorhynchus - Population
Studies
76-001293
- Oncorhynchus tshawytscha -
Culture/Propagation
76-000953
- Oncorhynchus tshawytscha -
Ergasilus
76-001155
- Oncorhynchus tshawytscha -
Feeding Experiments
76-000953
- Oncorhynchus tshawytscha -
Fish Passage
76-001260
- Oncorhynchus tshawytscha -
Jet Boats
76-001276
- Oncorhynchus tshawytscha -
Marking/Tagging
76-001246
- Oncorhynchus tshawytscha -
Movements
76-001260
- Oncorhynchus tshawytscha -
Parasites/Diseases
76-001155
- Oncorhynchus tshawytscha -
Parasitic Copepods
76-001155
- Ophisternon aenigmaticum -
New Species
76-001144
- Osmerus Perlanus morpha
spirinchus - Age/Growth
76-001264
- Osmerus Perlanus morpha
spirinchus - Mortality
Rates
76-001264
- Paratrimma - New Genus
76-001139
- Paratrimma nigrimenta - New
Species
76-001139
- Paratrimma urospila - New
Species
76-001139
- Perca flavescens -
Abundance/Factors of
76-001127
- Perca flavescens - Bayer 73
76-001179
- Perca flavescens -
Piscicides
76-001179

SPECIES INDEX

Perca flavescens - Temperature
 76-001127
Perca flavescens - TFM
 76-001179
Perca flavescens - Wind
 76-001127
Perca fluviatilis -
 Antiseptics
 76-001184
Perca fluviatilis - Spawning
 76-001059
Philypnodon breviceps -
 Foods/Feeding
 76-001075
Philypnodon breviceps -
 Foods/Feeding/Selectivity
 76-001074
Phoxinus phoxinus -
 Antiseptics
 76-001184
Pimephales promelas -
 Chromium
 76-001178
Pimephales promelas -
 Guthion
 76-001177
 76-001178
Pimephales promelas -
 Hydrogen Sulfide
 76-001189
 76-001204
Pimephales promelas -
 Insecticides
 76-001177
 76-001178
Pimephales promelas -
 Lernaean cyprinacea
 76-001160
Pimephales promelas -
 Parasites/Diseases
 76-001160
Pimephales promelas -
 Parasitic Copepods
 76-001160
Pimephales promelas -
 Pentachlorophenol
 76-001178
Pimephales promelas -
 Research Test Fish
 76-001178
Pimephales promelas -
 Sodium chloride
 76-001178
Platichthys stellatus -
 Parasites/Diseases
 76-001162

Platichthys stellatus -
 Tumors
 76-001162
Pleuronectes platessa -
 Heavy Metals
 76-001197
Pleuronectes platessa -
 Manganese
 76-001197
Pleuronectes platessa - Zinc
 76-001197
Poecilia latipinna - Endrin
 76-001202
Poecilia latipinna -
 Insecticides
 76-001202
Pomoxis annularis -
 Age/Growth
 76-001251
Pomoxis annularis -
 Distribution/Vertical
 76-001069
Pomoxis annularis - Forage
 Introductions
 76-001251
Pomoxis annularis - Trophic
 Relationships
 76-001251
Pomoxis nigromaculatus -
 Age/Growth
 76-001251
Pomoxis nigromaculatus -
 Forage Introductions
 76-001251
Pomoxis nigromaculatus -
 Modeling
 76-001266
Pomoxis nigromaculatus -
 Trophic Relationships
 76-001251
Protopterus aethiopicus -
 Aestivation
 76-000983
Protopterus aethiopicus -
 Blood Chemistry
 76-000983
Puzanovia rubra - New
 Species
 76-001138
Rastrelleger kanagurta -
 Predator/Prey
 Relationship
 76-001077
Rhinichthys atratulus -
 Chlorine
 76-001188

SPECIES INDEX

- Rhinichthys atratulus* - Sewage Effluents
 76-001188
Rutilus rutilus -
 Antiseptics
 76-001184
Rutilus rutilus - Fecundity
 76-001058
Rutilus rutilus -
 Reproduction
 76-001058
Rutilus rutilus - Spawning
 76-001057
Salmo aguabonita -
 Culture/Propagation
 76-000928
Salmo aguabonita -
 Hybridization
 76-000928
Salmo clarki - Dinoseb
 76-001210
Salmo clarki - Herbicides
 76-001210
Salmo clarki - Picloram
 76-001210
Salmo gairdneri - *Aeromonas*
liquefaciens
 76-001151
Salmo gairdneri - Bacterial
 Diseases
 76-001151
Salmo gairdneri - Bayer 73
 76-001179
Salmo gairdneri - Cadmium
 76-001181
Salmo gairdneri - Copper
 76-001181
 76-001190
Salmo gairdneri -
 Culture/Propagation
 76-000928
 76-000952
Salmo gairdneri - *Ergasilus*
 76-001155
Salmo gairdneri - Feeding
 Experiments
 76-000952
Salmo gairdneri - Gas
 Bubble Disease
 76-001157
Salmo gairdneri - Heavy
 Metals
 76-001181
 76-001182
 76-001190
 76-001194
Salmo gairdneri...continued
 Hybridization
 76-000928
Salmo gairdneri - Hydrogen
 Sulfide
 76-001204
Salmo gairdneri - Iron
 76-001181
Salmo gairdneri - Manganese
 76-001181
 76-001194
Salmo gairdneri -
 Marking/Tagging
 76-001246
Salmo gairdneri - Mercury
 76-001181
 76-001190
Salmo gairdneri - Mine
 Effluents
 76-001194
Salmo gairdneri -
 Parasites/Diseases
 76-001151
 76-001155
 76-001157
Salmo gairdneri - Parasitic
 Copepods
 76-001155
Salmo gairdneri - Piscicides
 76-001179
Salmo gairdneri - TFM
 76-001179
Salmo gairdneri - Zinc
 76-001181
Salmo salar - Aldrin
 76-001176
Salmo salar -
 Culture/Propagation
 76-000946
Salmo salar - DDT
 76-001176
Salmo salar - Feeders
 76-000946
Salmo salar - Heavy Metals
 76-001175
 76-001198
Salmo salar - Herbicides
 76-001198
Salmo salar - Hooking
 Mortality
 76-001238
Salmo salar - Insecticides
 76-001176
Salmo salar - Manganese
 76-001175
Salmo salar - Pesticides
 76-001198

SPECIES INDEX

- Salmo salar* - Temperature
 Selection
 76-001198
Salmo salar - Zinc
 76-001175
Salmo trutta - bayer 73
 76-001179
Salmo trutta - Cadmium
 76-001181
Salmo trutta caspius -
 Culture/Propagation
 76-000919
Salmo trutta - Copper
 76-001181
Salmo trutta - Ergasilus
 76-001155
Salmo trutta - Heavy Metals
 76-001175
 76-001181
Salmo trutta - Iron
 76-001181
Salmo trutta labrax - Blood
 Chemistry
 76-001001
Salmo trutta - Manganese
 76-001175
 76-001181
Salmo trutta - Mercury
 76-001181
Salmo trutta -
 Parasites/Diseases
 76-001155
Salmo trutta - Parasitic
 Copepods
 76-001155
Salmo trutta - Piscicides
 76-001179
Salmo trutta - TFM
 76-001179
Salmo trutta - Zinc
 76-001175
 76-001181
Salmonidae - Chemoreception
 76-000996
Salmonidae - Oxygen
 76-000992
Salmonidae - Pulp Mill
 Effluents
 76-001185
Salmonidae - Size Limits
 76-001235
Salvelinus fontinalis -
 Abnormalities
 76-000968
Salvelinus fontinalis -
 Bayer 73
 76-001179
Salvelinus fontinalis - Fil
 Clipping
 76-001245
Salvelinus fontinalis -
 Heavy Metals
 76-001191
Salvelinus fontinalis -
 Hybridization
 76-001249
Salvelinus fontinalis -
 Hydrogen Sulfide
 76-001204
Salvelinus fontinalis - Lea
 76-001191
Salvelinus fontinalis -
 Piscicides
 76-001179
Salvelinus fontinalis -
 Spawning
 76-001066
Salvelinus fontinalis -
 Stocking/Introductions
 76-001249
 76-001250
Salvelinus fontinalis -
 Stream
 Improvement/General
 76-001225
Salvelinus fontinalis - TFM
 76-001179
Salvelinus malma - Minnow
 Traps
 76-001253
Salvelinus namaycush -
 Bayer 73
 76-001179
Salvelinus namaycush -
 Culture/Propagation
 76-000948
 76-000949
Salvelinus namaycush -
 Dinoseb
 76-001210
Salvelinus namaycush -
 Feeding Experiments
 76-000948
 76-000949
Salvelinus namaycush -
 Herbicides
 76-001210
Salvelinus namaycush -
 Picloram
 76-001210
Salvelinus namaycush -
 Piscicides
 76-001179

SPECIES INDEX

- Salvelinus namaycush - TFM
76-001179
- Sardinops sagax -
Foods/Feeding/Selectivity
76-001073
- Schizothorax intermedius
eurycephalus - Life
History/General
76-001022
- Scomberesox saurus -
Distribution/Geographical
76-001108
- Scyliorhinus canicula -
Nidamental Gland
76-000999
- Seriola dumerili -
Distribution/Geographical
76-001110
- Sparidae - Life
History/General
76-001029
- Stenodus leuchichthys -
Culture/Propagation
76-001049
- Stenodus leuchichthys -
Population Studies
76-001049
- Stenodus leuchichthys -
Stocking/Introductions
76-001049
- Stichaeus punctatus -
Distribution/Geographical
76-001031
- Stichaeus punctatus -
Identification
76-001137
- Stichaeus punctatus - Life
History/General
76-001031
- Stizostedion canadense -
Abundance/Factors of
76-001135
- Stizostedion canadense -
Foods/Feeding
76-001135
- Stizostedion canadense -
Predator/Prey
Relationships
76-001135
- Stizostedion vitreum
vitreum -
Abundance/Factors of
76-001135
- Stizostedion vitreum
vitreum -
Culture/Propagation
76-000947
- Stizostedion vitreum
vitreum - Feeding
Experiments
76-000947
- Stizostedion vitreum
vitreum - Foods/Feeding
76-001135
- Stizostedion vitreum
vitreum - Hydrogen
Sulfide
76-001204
- Stizostedion vitreum
vitreum - Movements
76-001070
- Stizostedion vitreum
vitreum - Predator/Prey
Relationships
76-001135
- Synbranchidae - New Species
76-001144
- Tetrapturus audax -
Age/Growth
76-001101
- Thallasoma - Predator/Prey
Relationship
76-001077
- Thunnus alalunga -
Marking/tagging
76-001243
- Thunnus albacares -
Age/Length Composition
76-001294
- Thunnus obesus - Age/Length
Composition
76-001294
- Thymallus arcticus
baicalensis - Metabolic
Rates
76-001004
- Thymallus arcticus -
Parasites/Diseases
76-001164
- Thymallus arcticus -
Tetraonchus rauschi
76-001164
- Thymallus arcticus -
Trematodes
76-001164
- Tilapia aurea -
Foods/Feeding
76-001090
- Tilapia aurea - Temperature
76-000981
- Tilapia galilaea -
Foods/Feeding
76-001090

SPECIES INDEX

- Tilapia nilotica - Temperature
76-000981
- Tilapia vulcani -
Temperature
76-000981
- Trachurus declivis -
Age/Growth
76-001098
- Trachurus mediterraneus
ponticus -
Abundance/Factors of
76-001131
- Trachurus symmetricus -
Foods/Feeding/Selectivity
76-001073
- Trachurus trachurus -
Maturity
76-001063
- Trachurus trachurus -
Spawning
76-001063
- Ulvaria subbifurcata -
Identification
76-001137
- Verasper moseri -
Parasites/Diseases
76-001162
- Verasper moseri - Tumors
76-001162
- Zoarcidae - New Species
76-001138

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.



UNITED STATES
DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE
EDITORIAL OFFICE
AYLESWORTH HALL, CSU
FORT COLLINS, COLORADO 80523

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF THE INTERIOR

INT 423



LIBRARY
NATL MAR FISH SERV
PO BOX 3830
HONOLULU, HI 96812

626126

NOTE: Please return address label with change of address.